EXHIBIT A

Technical Update and Conceptual Path Forward - 2020

Northrop Grumman Missions Systems
Former Litton Systems Facility
Springfield, Missouri

Presentation Date: January 29, 2020

Agenda

"I suppose you're all wondering why I've called you here. Oh, wait, there's an agenda. Never mind."

Agenda

I. Recap from November 2019 Public Meeting
II. Fantastic Caverns Update
III. Brief Overview of Site History
IV. Status of On-Going Remedial Investigation Activities
V. Status of On-Going Remedial System Expansions
VI. Overview of Conceptual Site Model
VII. Data Objectives to Complete the Remedial Investigations
VIII. Path Forward to the Feasibility Study

Recap from November 2019 Public Meeting

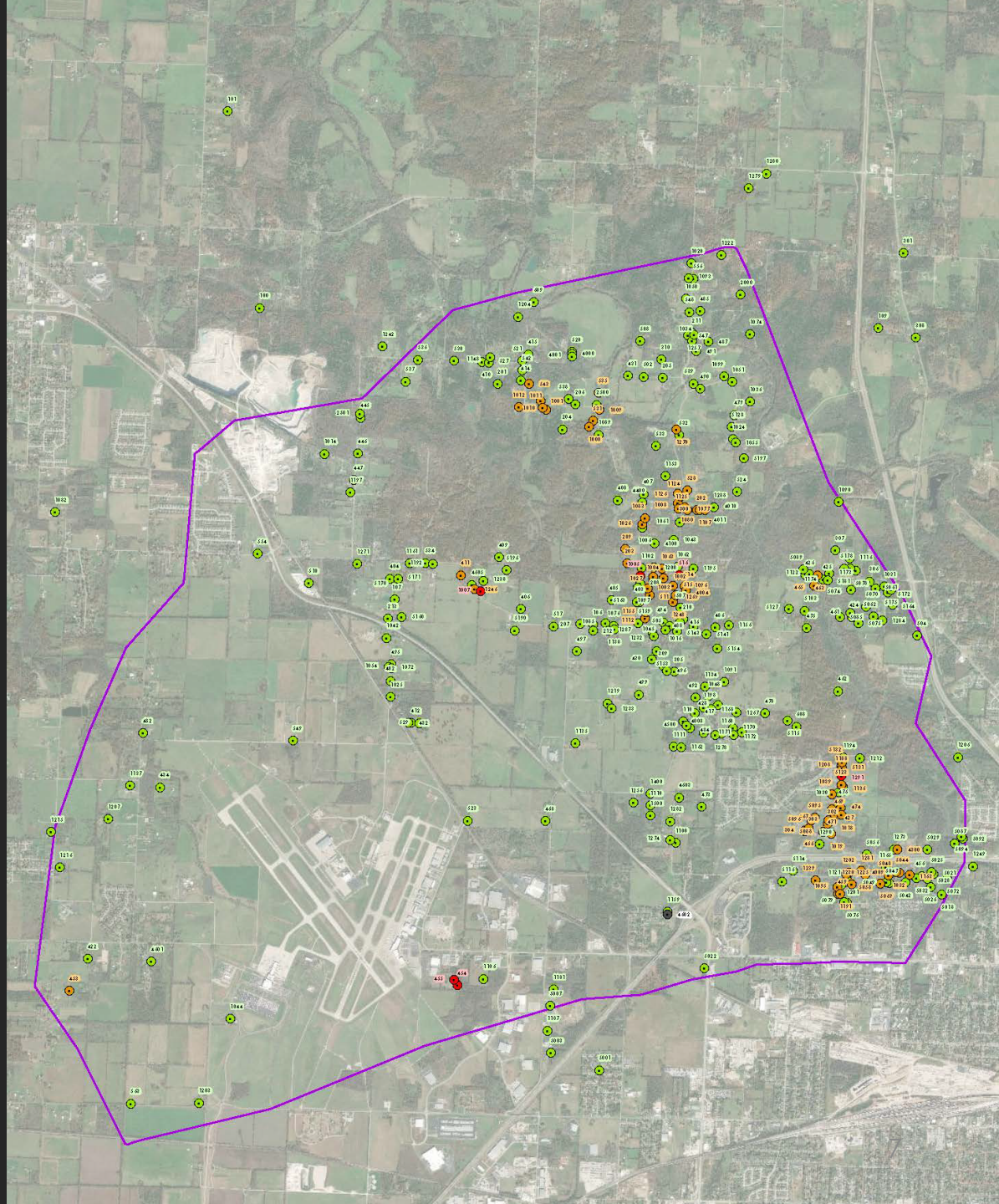
Key Topics from Public Meeting

- Domestic Well Sampling Program
  - Sampling Frequency
  - Data "Variability"
- Timeline for Final Remedial Plan
- Department of Health and Senior Services (DHSS) Public Health Consultation

Domestic Well Sampling Program

- Total Wells in the Program = 357
- Wells with TCE Presently > MCL = 5
- Wells with Detectable TCE and/or Degradation Byproducts = 86
- Wells in the "ND Subset" = 271
- Wells Sampled in January 2020 = 99
  - Wells with Detectable TCE and/or Degradation Byproducts = 66
  - Wells in the "ND Subset" = 13

Domestic Well Sampling Program



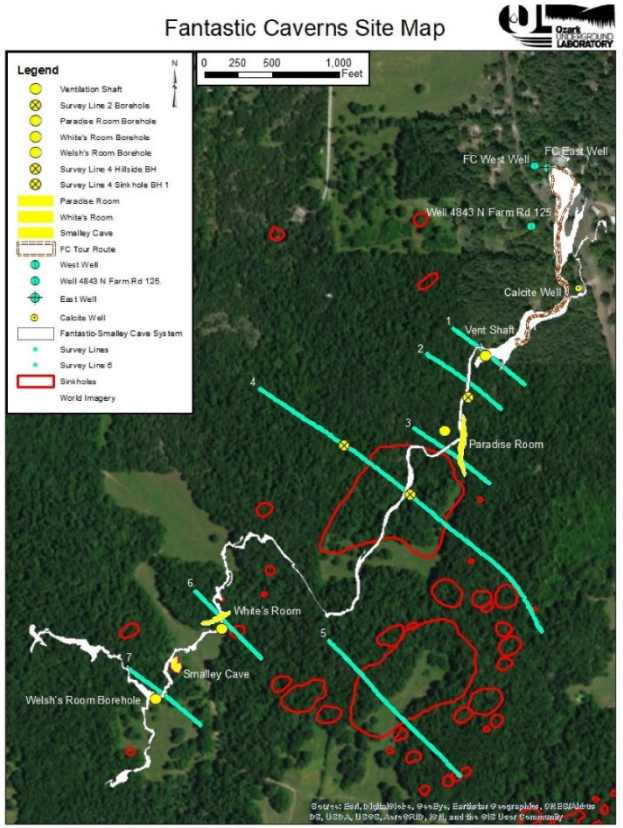
Fantastic Caverns Update

Fantastic Caverns Update

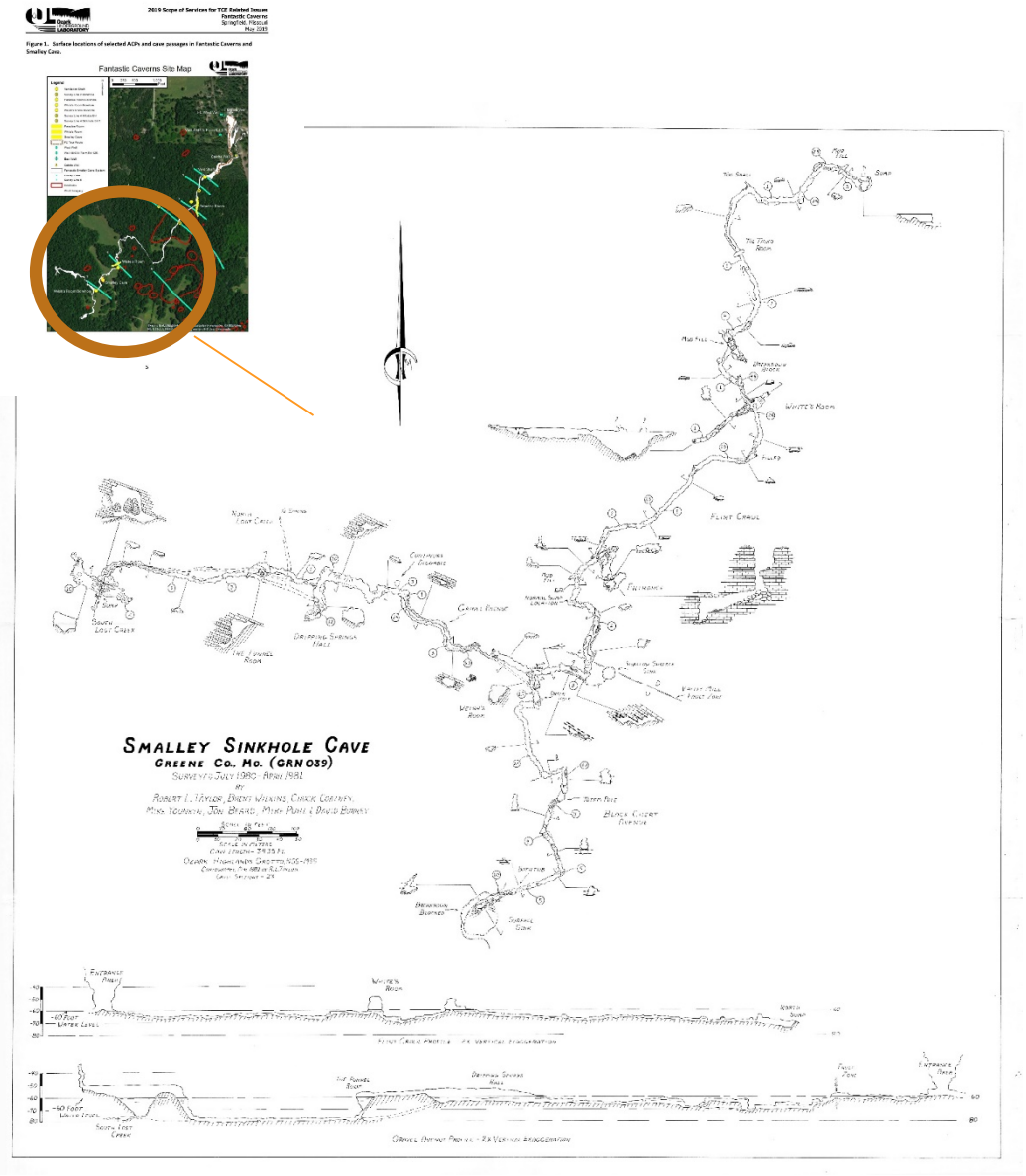
- Agreements in Place
- Monthly Sampling Confirms TCE Levels in the Caverns are Below 6.0 µg/L
- Mitigations via Borehole Venting Appears to be Effective
- Fantastic Caverns has Developed a Detailed Work Scope for Q1 2020
  - Continued Sampling
  - Development of Work Plan Documents
  - Refinement of Mitigations
- Data Transmittals to MoDNR

Geophysical Lines and Boreholes

Figure 1. Surface locations of selected ACPs and cave passages in Fantastic Caverns and Smalley Cave.



Cave Features



Recent Fantastic Caverns Data

8-hour Summa Canister Measurements of TCE (µg/m³)														
Location	**3/27/19**	**4/30/19**	**5/24/19 ***	**6/26/19**	**7/9/19**	**7/23/19**	**8/12/19**	**8/24/19**	**9/11/19**	**9/25/19**	**10/14/19**	**10/31/19**	**11/17/19**	**December**
Lobby									0.0	0.20	0.0	0.0		
Passage Behind Underground Classroom									0.0	0.0	0.0	1.5		
Auditorium Stage									0.0	0.18	0.35	0.0		
Hall of Giants									0.0	0.18	0.34	0.0		
Mushroom Beds			4.4											
Breakdown			3.0											
Lower Passage - Upstream	82	8.5		4.3	2.3	0.70	0.24	0.24	0.0	0.23	0.34	LP Flow		
Lower Passage - Downstream				28	18	4.2	1.4	1.7	1.5	1.0	12	LP Flow		
South Side of Canyon												1.2		
North Side of Sinkhole												2.0		
Mud Bank Past Projector	0.92	0.28		0.44	0.0	0.0	0.0	0.0	0.0	0.18	0.0	0.87		
Tour Jeep	0.48	0.16		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.32		
Top of Vent Shaft V1			2.7											
Paradise Room BH V3			17	2.7	1.4	0.51	0.22	0.26	0.0	0.23	0.35	60		
White's Room BH V7			9.0	1.7	2.6	0.31	0.51	0.61	0.61	0.53	0.35	230		
Welsh's Room BH V8			0.41	5.6	360	240	250	150	180	160	620	0.0		
Smalley Cave	0.33	0.41	0.29											

Blank cells = No sample collected at that location

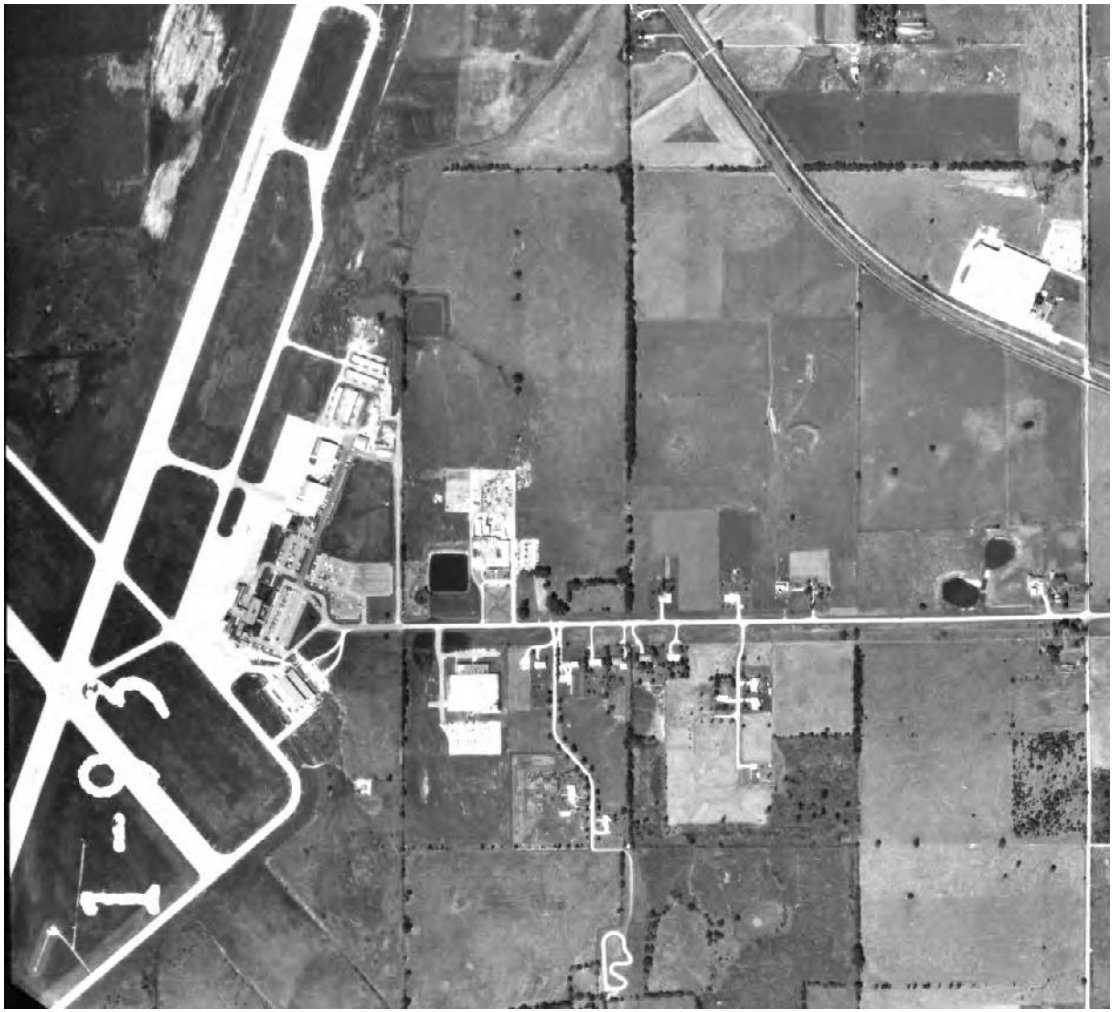
* = Cave flooded limiting sampling locations and sampled while venting out of V1 only

LP Flow : When the lower passage has flow, Summa canisters normally placed in the upstream and downstream sections of the Lower Passage are placed on the tour level on the north side of the sinkhole and on the south side of the Canyon peering into the lower passage

8-hour Summa Canister Measurements of TCE (µg/m³)					
Location	9/11/19	9/25/19	10/14/19	10/31/19	11/17/19
Lobby	0.0	0.20	0.0	0.0	
Passage Behind Underground Classroom	0.0	0.0	0.0	1.5	
Auditorium Stage	0.0	0.18	0.35	0.0	
Hall of Giants	0.0	0.18	0.34	0.0	
Mushroom Beds					
Breakdown					
Lower Passage - Upstream	0.0	0.23	0.34	LP Flow	0.0
Lower Passage - Downstream	1.5	1.0	12	LP Flow	6.1
South Side of Canyon				1.2	
North Side of Sinkhole				2.0	
Mud Bank Past Projector	0.0	0.18	0.0	0.87	0.0
Tour Jeep	0.0	0.0	0.0	0.32	0.0
Top of Vent Shaft V1					
Paradise Room BH V3	0.0	0.23	0.35	60	0.0
White's Room BH V7	0.61	0.53	0.35	230	0.22
Welsh's Room BH V8	180	160	620	0.0	240
Smalley Cave					

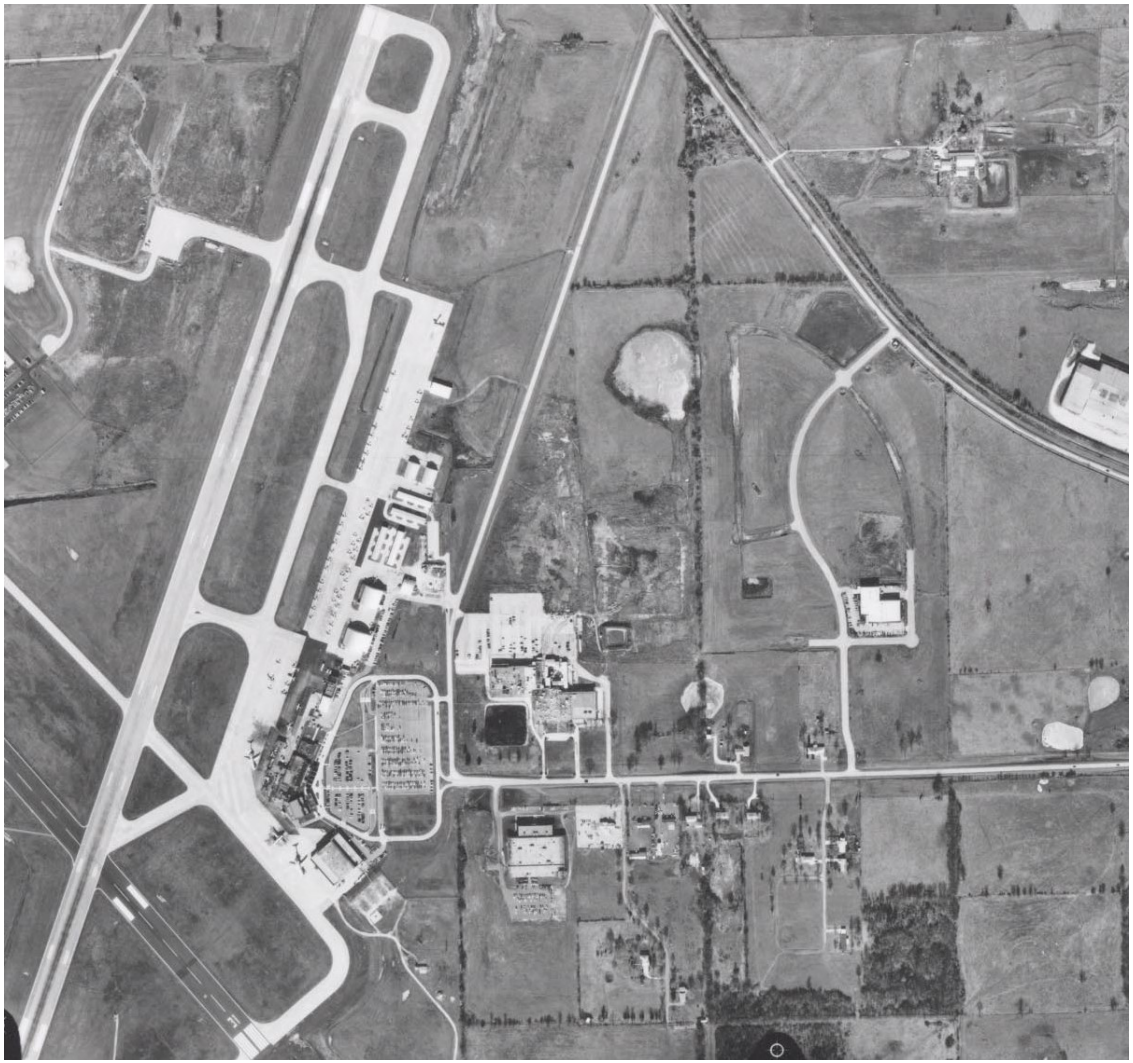
Brief Overview of Site History

1970



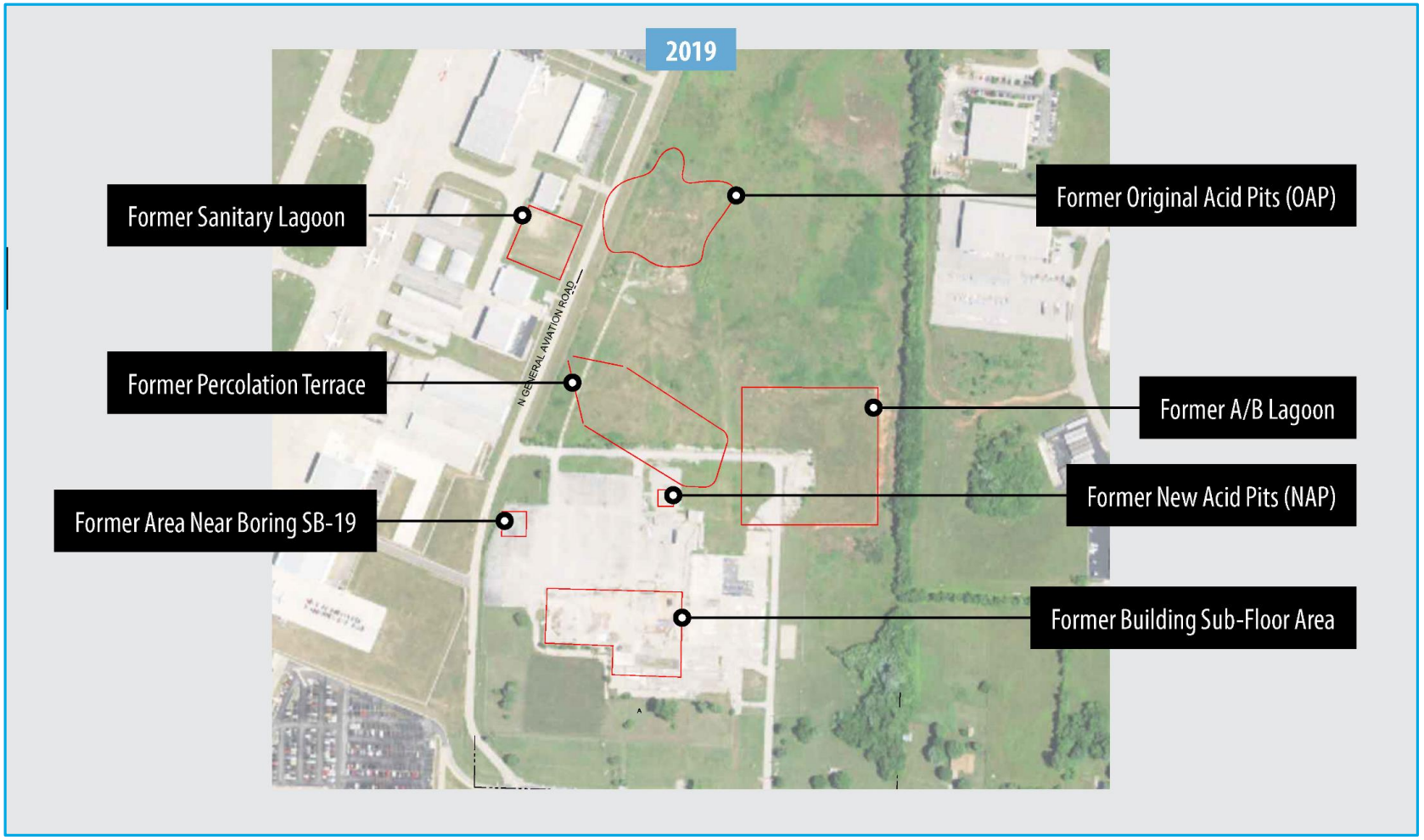
1975

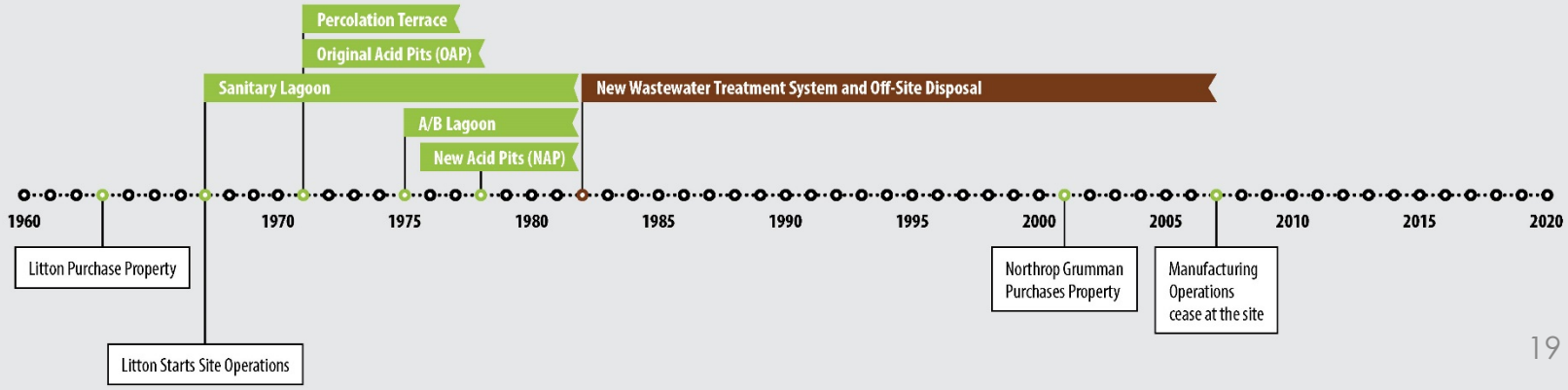
1985



1970

1975


2019
Former Sanitary Lagoon
Former Original Acid Pits (OAP)
Former Percolation Terrace
Former A/B Lagoon
Former New Acid Pits (NAP)
Former Area Near Boring SB-19
Former Building Sub-Floor Area
N GENERAL AVIATION ROAD

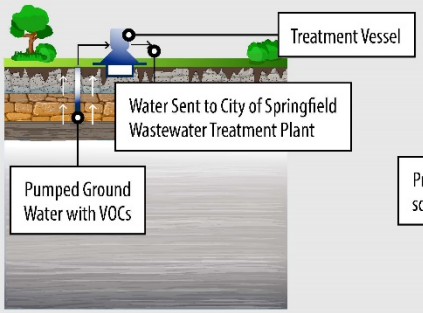

Percolation Terrace
Original Acid Pits (OAP)
Sanitary Lagoon
New Wastewater Treatment System and Off-Site Disposal
A/B Lagoon
New Acid Pits (NAP)
1960
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Litton Purchase Property
Litton Starts Site Operations
Northrop Grumman Purchases Property
Manufacturing Operations cease at the site

Summary of Remedial Activities

- Vadose Zone Treatment
  - Electrical Resistive Heating (ERH) at the SB-19 Area, New Acid Pits (NAP), and Old Acid Pits (OAP)
  - Excavation and Capping of Copper Impacted Soils at OAP and A/B Lagoon
  - Excavation of Copper Impacted Soils at the Former Building Sub-Floor
  - Soil Mixing and Enhanced In-Situ Bioremediation (EISB) at the OAP, Former Sanitary Lagoon, and Building Sub-Floor
- Groundwater
  - EISB at the OAP, NAP, Former Sanitary Lagoon, and Building Sub-Floor
  - Extraction and Treatment of Groundwater from the Springfield and Ozark Aquifers

Remediation of VOCs in Soil and Groundwater

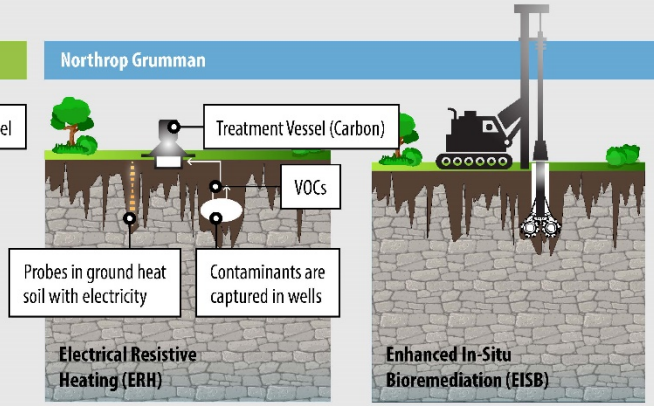
Litton Systems



Between 1995 and 2001 Litton Systems Pumped and Treated 6 million Gallons of groundwater from 12 Springfield Aquifer Wells. Approximately **3,000 lbs** of VOCs were removed.

Litton removed **430 lbs** of VOCs from soil at the New Acid Pit (NAP) using Vacuum Extraction.

Northrop Grumman

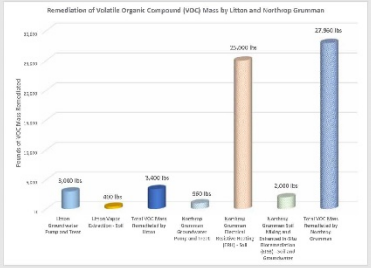


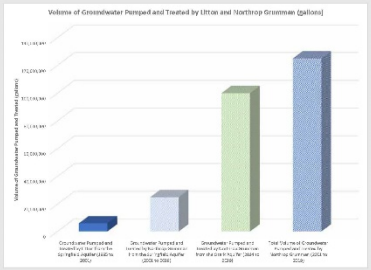
Using Electrical Resistive Heating (ERH) Northrop Grumman removed approximately **25,000 lbs** of VOCs from soil at the NAP, Original Acid Pits (OAP), and SB-19 Area.

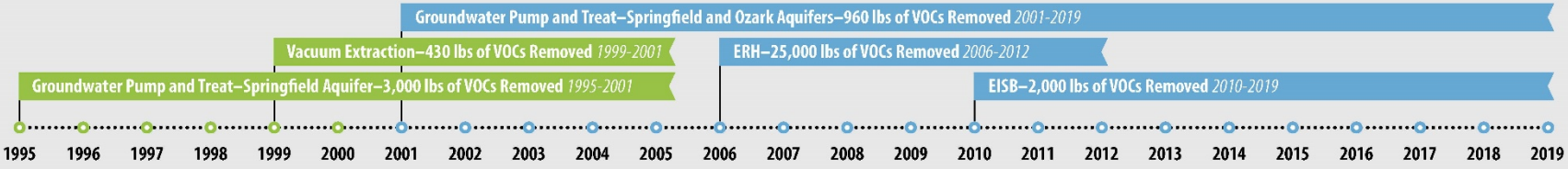
Using enhanced In-situ Bioremediation (EISB) techniques, Northrop Grumman has removed an estimated **2,000 lbs** of VOCs from soil and groundwater at the NAP, OAP, Former Sanitary Lagoon, and former Building Areas.

Northrop Grumman has pumped and treated 25 million Gallons of Springfield Aquifer groundwater, 100 million gallons of Ozark Aquifer groundwater, and **960 lbs** of VOCs have been treated.

Groundwater Extraction and Treatment





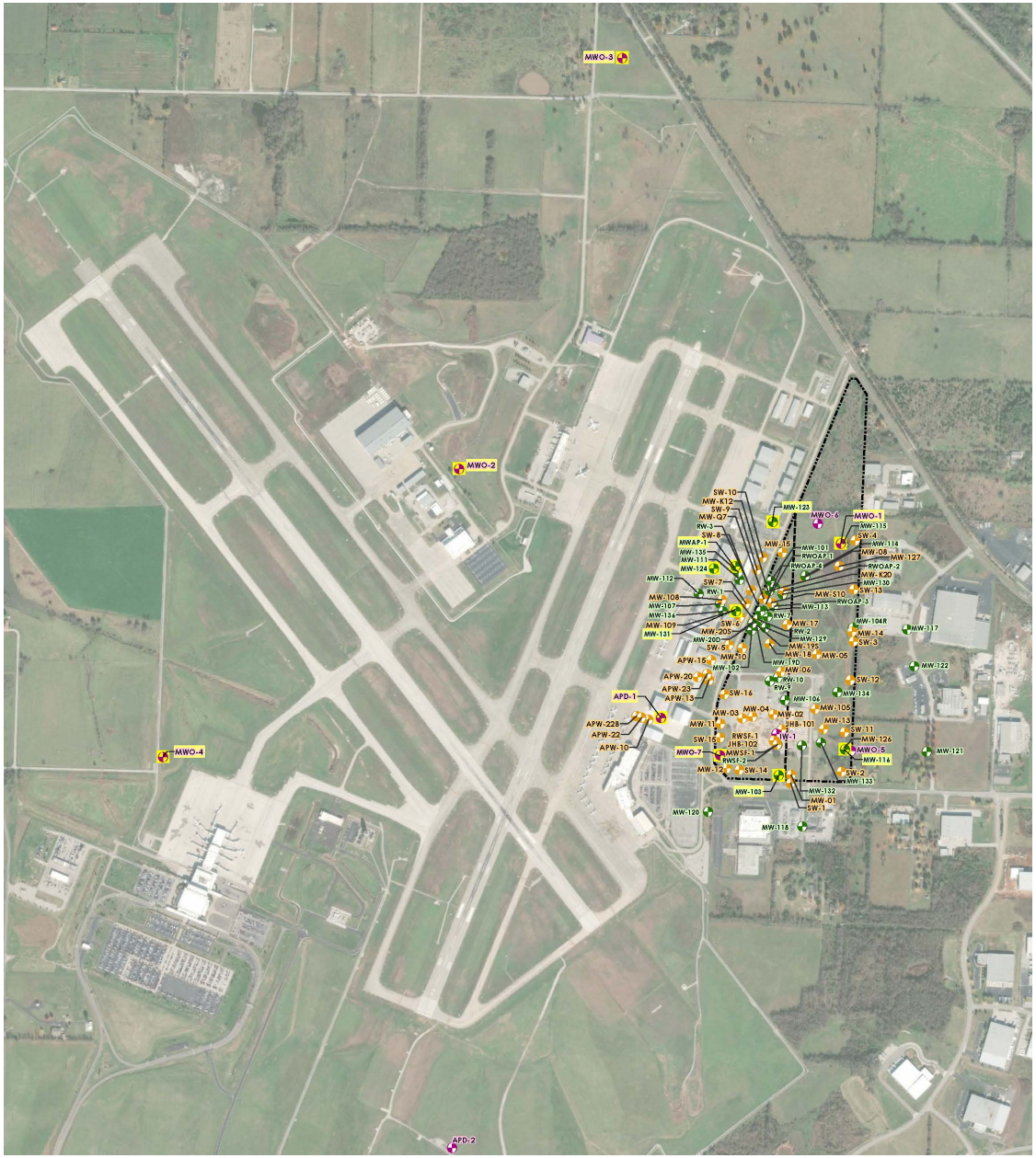


Status of On-Going Remedial Investigation Activities

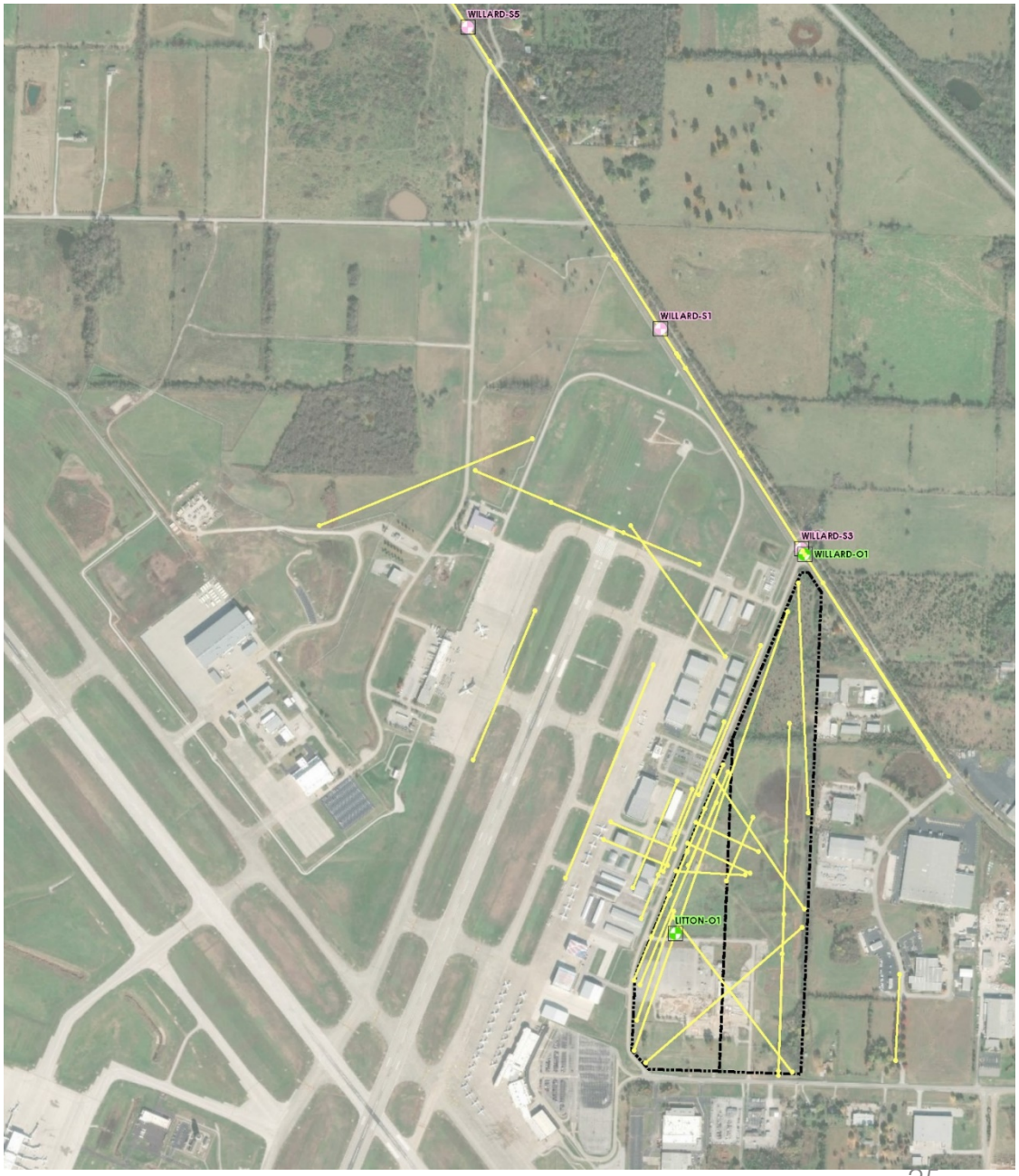
Status of On-Going Remedial Investigation Activities

- Downhole Geophysics
  - Existing Monitoring Wells
  - Domestic Wells
- Installation and Testing of Ozark Monitoring Wells
- Installation and Testing of Springfield Monitoring Wells
- Sampling of Saturated Sediments in "Cutter Features" at the OAP, Former Sanitary Lagoon, and Former Building Sub-Floor Area
- 2019 Annual Groundwater Monitoring Event
- Shallow Soil Vapor Sampling and Hanger Sampling

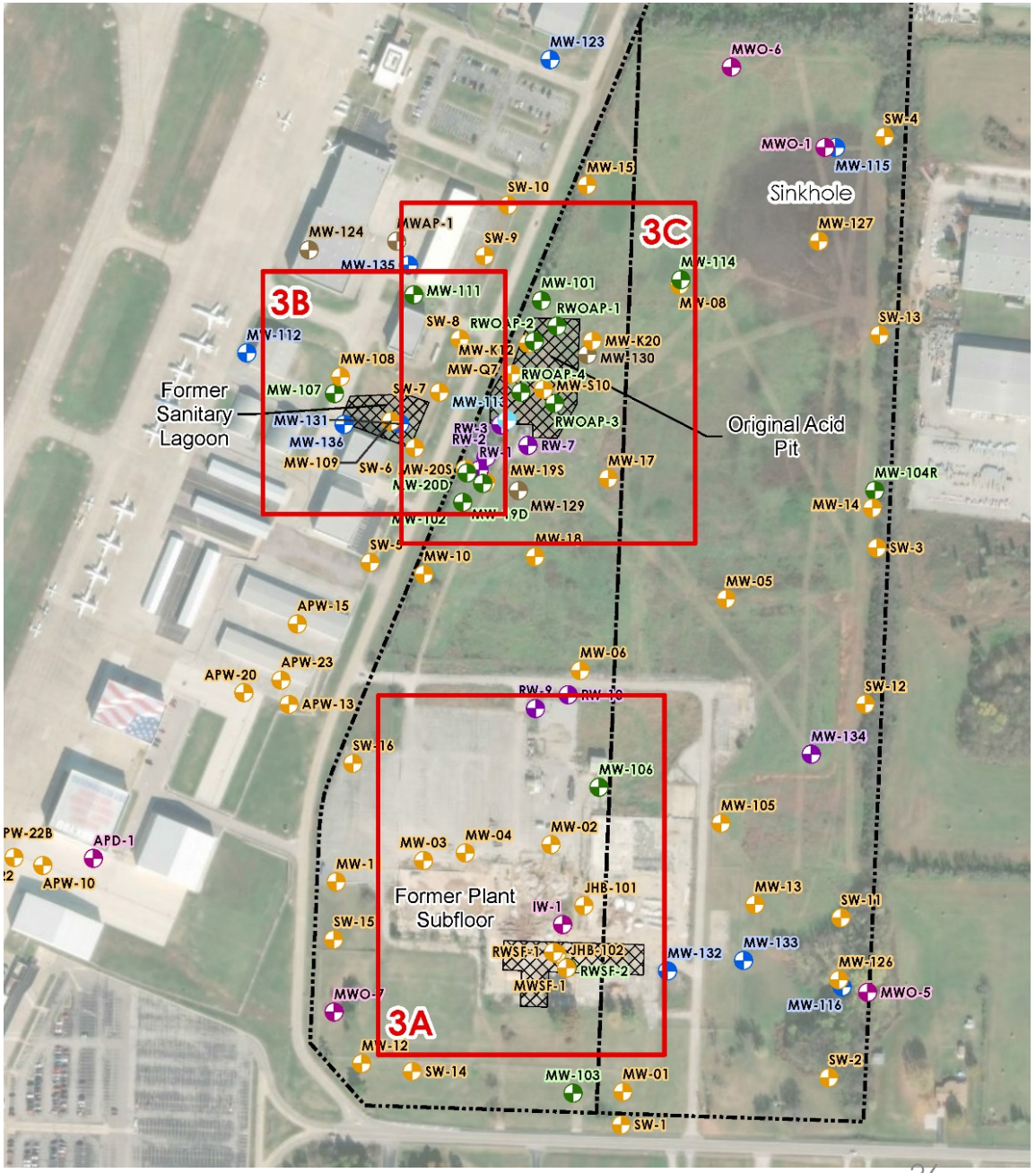
Downhole Geophysics

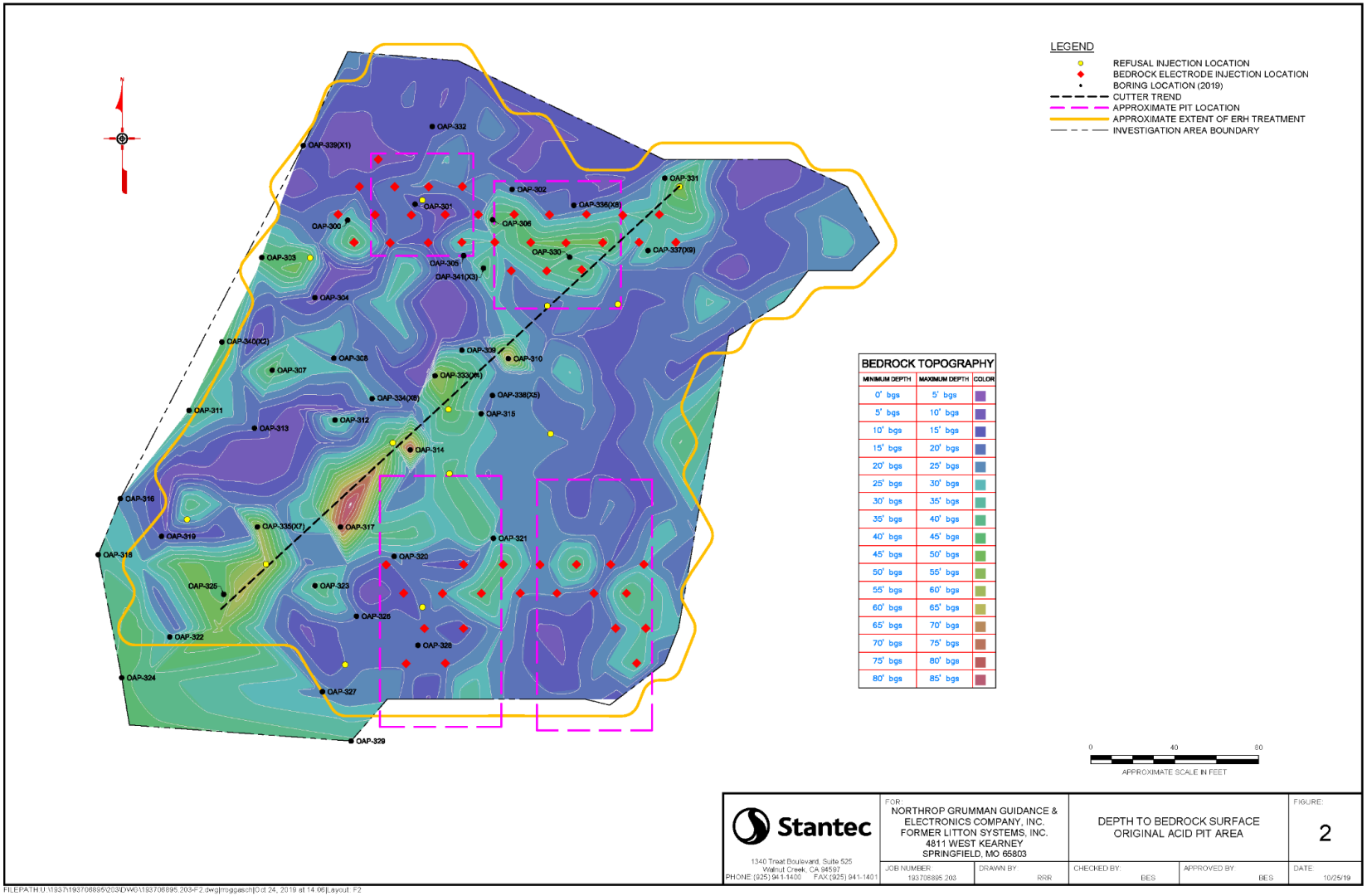


Current Well Drilling

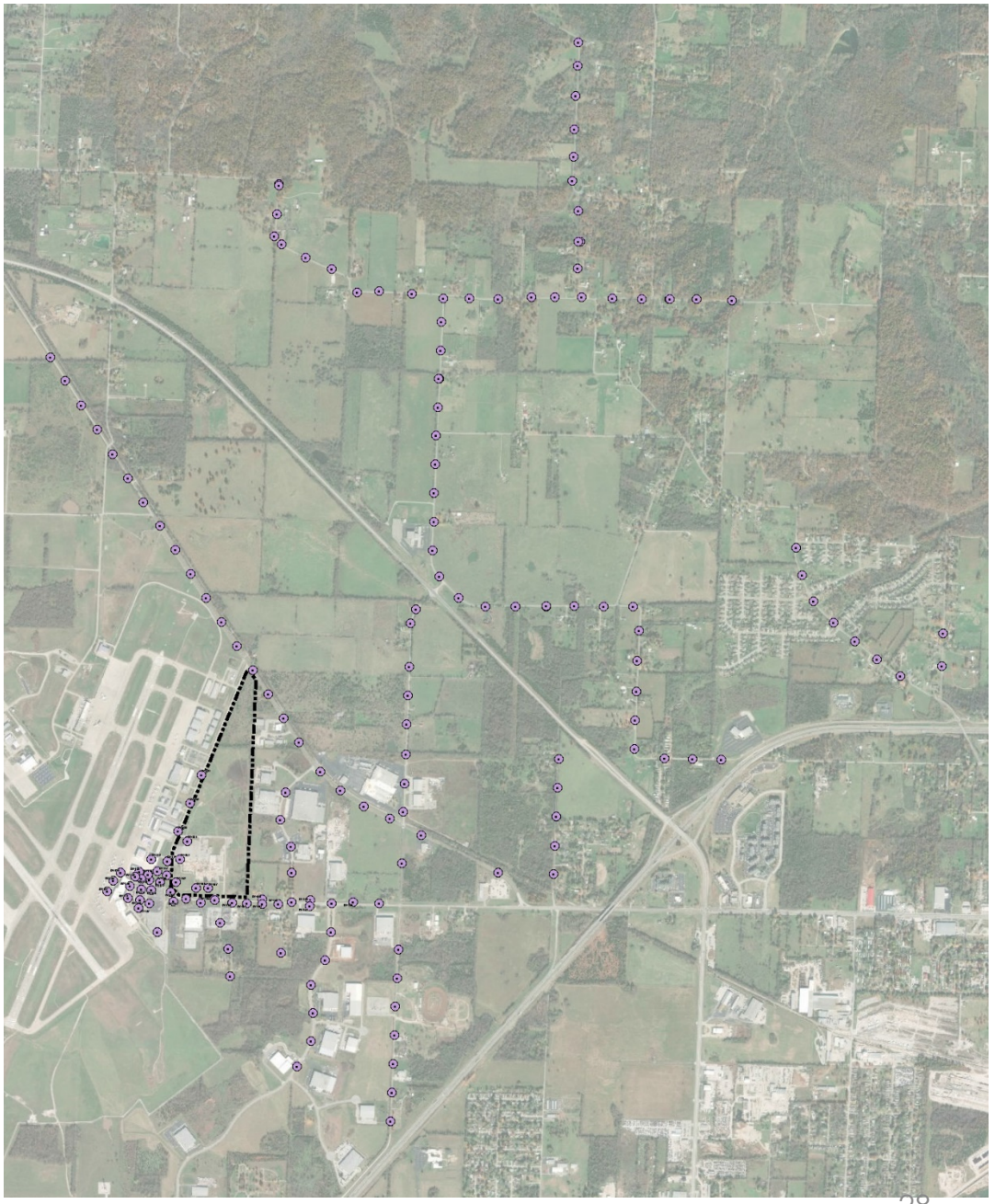


Cutter Evaluations

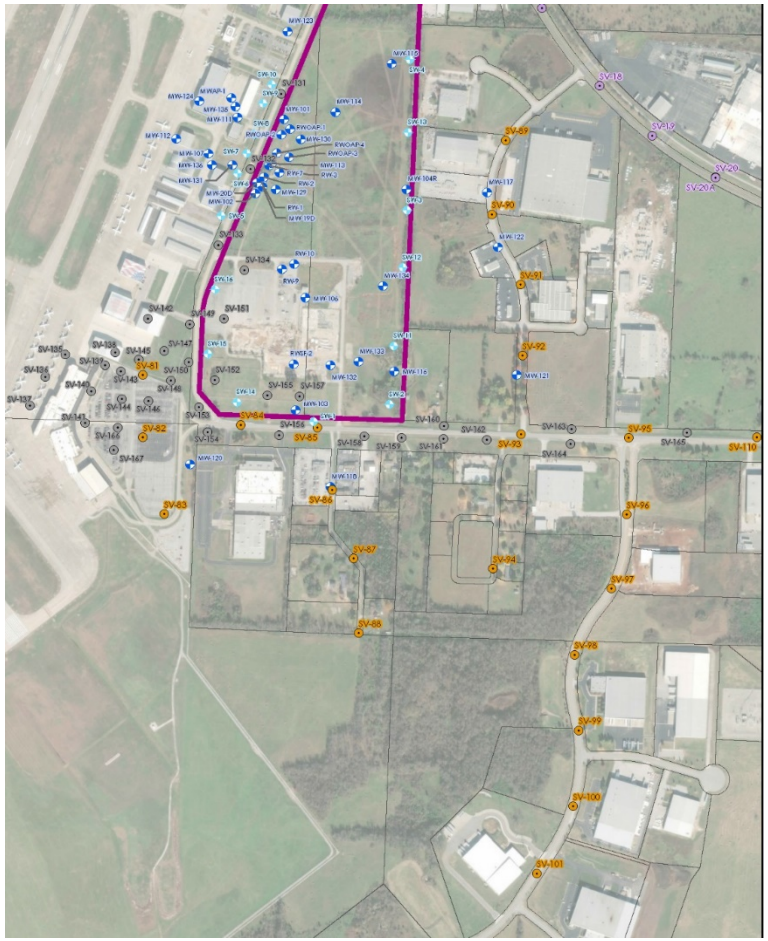



LEGEND
REFUSAL INJECTION LOCATION
BEDROCK ELECTRODE INJECTION LOCATION
BORING LOCATION (2019)
CUTTER TREND
APPROXIMATE PIT LOCATION
APPROXIMATE EXTENT OF ERH TREATMENT
INVESTIGATION AREA BOUNDARY
OAP-332
OAP-339(X1)
OAP-331
OAP-302
OAP-301
OAP-336(X8)
OAP-300
OAP-306
OAP-303
OAP-330
OAP-337(X9)
OAP-305
OAP-341(X3)
OAP-304
OAP-340(X2)
OAP-309
OAP-310
OAP-308
OAP-307
OAP-333(X6)
OAP-334(X8)
OAP-336(X5)
OAP-311
OAP-315
OAP-313
OAP-312
OAP-314
OAP-316
OAP-335(X7)
OAP-317
OAP-319
OAP-321
OAP-318
OAP-320
OAP-325
OAP-323
OAP-326
OAP-322
OAP-328
OAP-324
OAP-327
OAP-329
BEDROCK TOPOGRAPHY
MINIMUM DEPTH | MAXIMUM DEPTH | COLOR
0' bgs | 5' bgs
5' bgs | 10' bgs
10' bgs | 15' bgs
15' bgs | 20' bgs
20' bgs | 25' bgs
25' bgs | 30' bgs
30' bgs | 35' bgs
35' bgs | 40' bgs
40' bgs | 45' bgs
45' bgs | 50' bgs
50' bgs | 55' bgs
55' bgs | 60' bgs
60' bgs | 65' bgs
65' bgs | 70' bgs
70' bgs | 75' bgs
75' bgs | 80' bgs
80' bgs | 85' bgs
0
40
80
APPROXIMATE SCALE IN FEET
Stantec
1340 Treat Boulevard, Suite 525
Walnut Creek, CA 94597
PHONE: (925) 941-1400 FAX (925) 941-1401
FOR:
NORTHROP GRUMMAN GUIDANCE & ELECTRONICS COMPANY, INC.
FORMER LITTON SYSTEMS, INC.
4811 WEST KEARNEY
SPRINGFIELD, MO 65803
DEPTH TO BEDROCK SURFACE
ORIGINAL ACID PIT AREA
FIGURE:
2
JOB NUMBER: 193708895.203
DRAWN BY: RRR
CHECKED BY: BES
APPROVED BY: BES
DATE: 10/25/19
FILEPATH:U:\193\193708895\203\DWG\193708895.203-F2.dwg|mroggasch|Oct 24, 2019 at 14:06|Layout: F2

Soil Vapor Sampling Completed to Date



Sampling Locations



Sampling Location

- 2018 Stantec Soil Vapor Sampling Locations
- March 2019 Stantec Soil Vapor Sampling Locations
- June / July 2019 Stantec Soil Vapor Sampling Locations

Upcoming Work Plan for Soil Vapor and Hanger Sampling at the Airport

TCE Concentration

- ≤ MDL (typically 2.1 µg/m³)
- > MDL and ≤ 10 µg/m³ (includes J flags ≤ 2.1)
- > 10 and ≤ 100 µg/m³
- > 100 and ≤ 292 µg/m³
- > 292 and ≤ 1,000 µg/m³
- > 1,000 µg/m³
- Not Sampled

Status of On-Going Remedial System Expansions

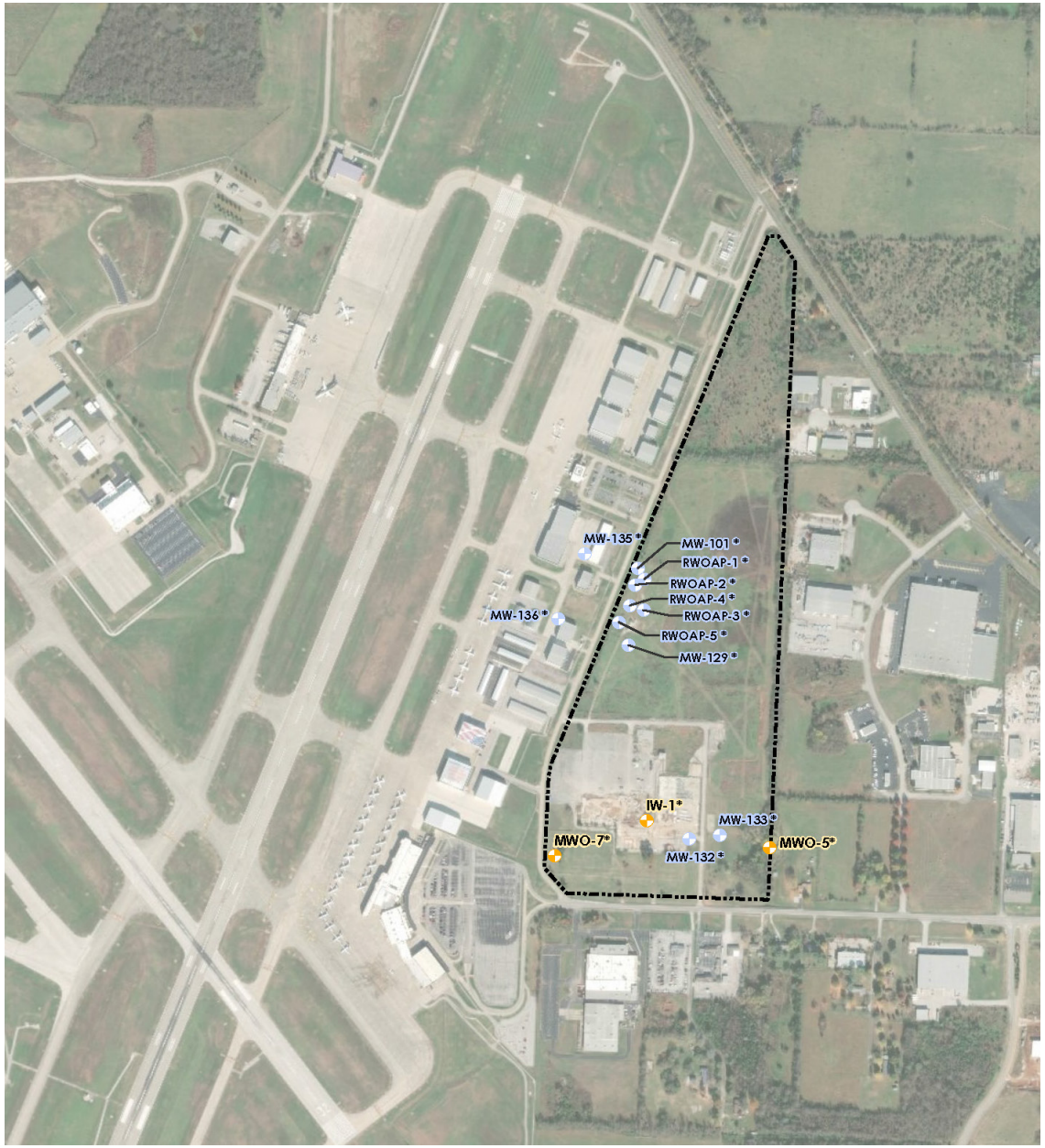
Status of On-Going Remedial System Expansions – Ozark Aquifer

- IW-01 Currently Operating – 95 to 100 gpm
- Piping Connections Complete - MWO-05 and MWO-07
- Expanded System Start-Up Scheduled for Q1 2020

Status of On-Going Remedial System Expansions – Springfield Aquifer

- MW-129, -135, and -135 System in Operation – 12 gpm
- Updated System will have 12 Pumping Wells
  - 3 in Sub-Floor Area (New Well, MW-132, MW-133)
  - 2 at the Airport (MW-135 and MW-136)
  - 7 at the OAP (MW-129, MW-101, RW-OAP1 to RW-0AP5)
- Permitting for New Treatment Building
- System Design Updates
- Well Installations and Pump Testing
- Piping, Well Vaults, Pump Installations
- Electrical Connections
- Expanded System Start-Up Scheduled for Q2 2020

Current System Expansions



Treatment System Overview

Operation and Maintenance Monthly Progress Report
Northrop Grumman Guidance Company, Inc.

Formerly Litton Systems, Inc.
4811 West Kearney
Springfield, Missouri

Stantec

November 2019

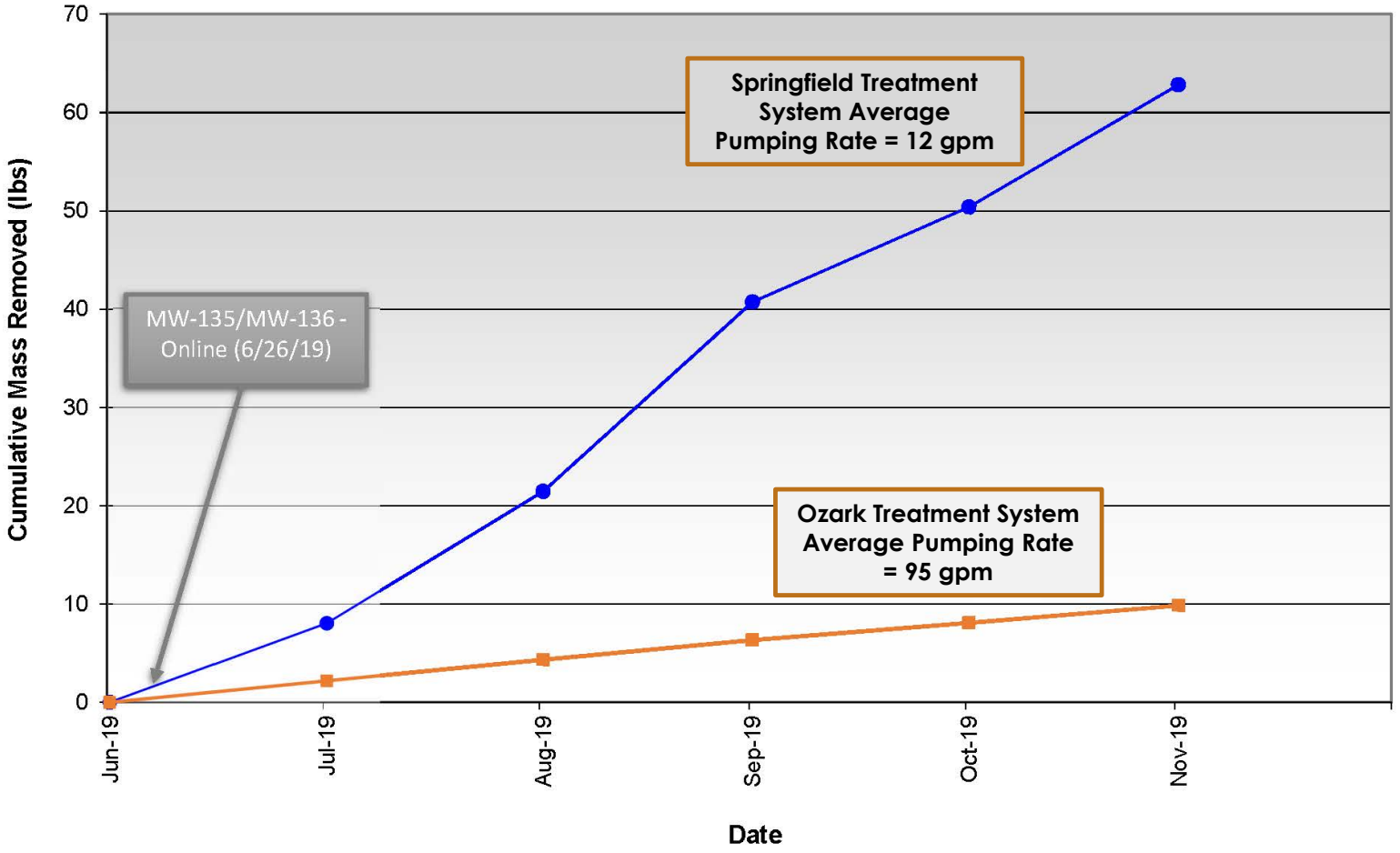
OZARK REMEDIATION SYSTEM STATUS AND ACTIVITY

Remediation System Equipment	Air Stripper (one unit)
Wells online this month	IW-1
System Operation / Up-Time *(hours)*	703
Percent Up- Time this Month	98%
Total groundwater extracted, treated, and discharged this month *(gallons)*	4,134,124
Total treated groundwater discharged to sanitary sewer system this month *(gallons)*	4,134,124
Average daily discharge of treated groundwater to sanitary sewer system *(gallons)*	137,804
Average flowrate of groundwater extracted and treated *(gallons per minute)*	95.7
Mass VOCs Removed *(pounds per month)*	1.77
Total groundwater reinjected this month *(gallons)*	0

SPRINGFIELD REMEDIATION SYSTEM STATUS AND ACTIVITY

Remediation System Equipment	Air Stripper (one unit)
Wells online this month	MW-129, MW-135, MW-136
System Operation / Up-Time *(hours)*	720
Percent Up- Time this Month	100%
Total groundwater extracted, treated, and discharged to sanitary sewer system this month *(gallons)*	501,499
Average daily discharge of treated groundwater to sanitary sewer system *(gallons)*	16,717
Average flowrate of groundwater extracted and treated *(gallons per minute)*	11.6
Mass VOCs Removed *(pounds per month)*	12.43

Graph 1
Cumulative VOC Mass Removed in Groundwater vs. Time
Northrop Grumman
Springfield, Mo

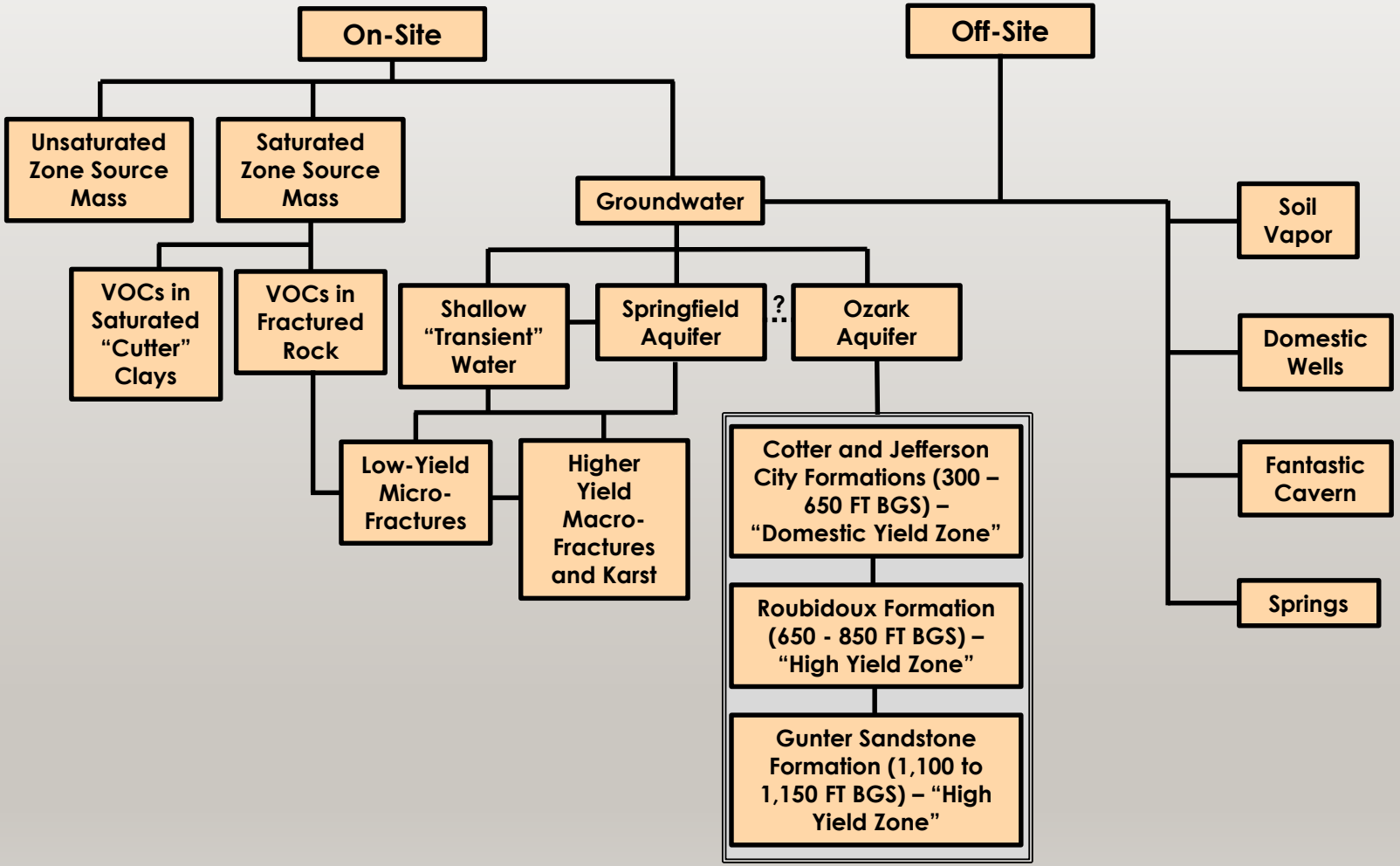


Conceptual Site Model (CSM) - Geology and Hydrogeology

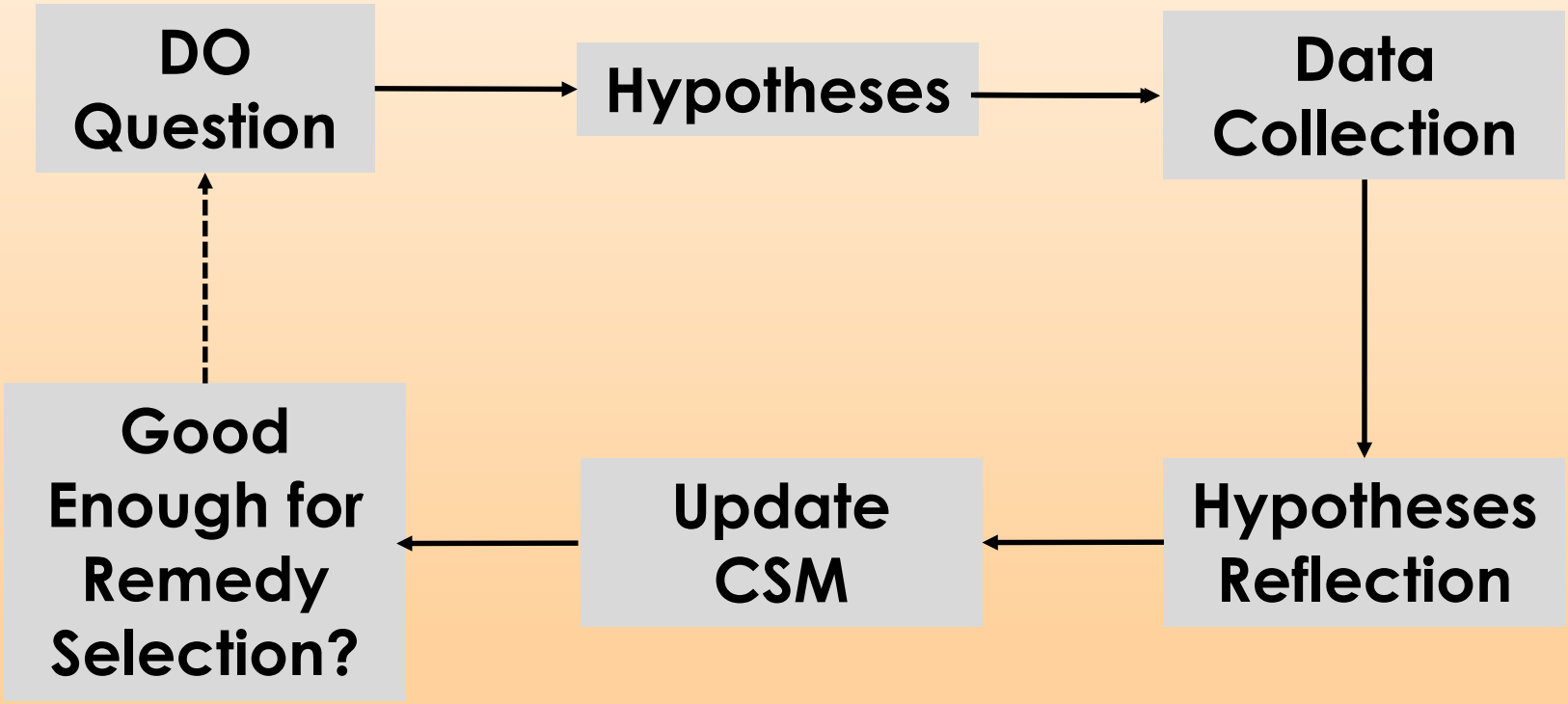
Is this a CSM?


LOOK, HOBBES, I GOT A MODEL AIRPLANE. WANT TO HELP ME BUILD IT?
SURE.
WOW, A PHANTOM JET! I CAN'T WAIT UNTIL IT'S DONE!
LOOK AT ALL THE LITTLE PIECES.
HERE, YOU PUT THOSE PIECES TOGETHER, AND I'LL DO THESE. THEN WE'LL STICK YOURS ON MINE, OK?
SHOULDN'T WE READ THE INSTRUCTIONS?
DO I LOOK LIKE A SISSY?
I CAN'T GET THIS MODEL AIRPLANE TO LOOK RIGHT.
THESE DIRECTIONS ARE IMPOSSIBLE!
RRRRRGGGHHHHH
WHAM
HAM
HAM
HIT BY ANTI-AIRCRAFT GUNS.
YOUR PLANES DO SEEM TO RUN INTO THOSE, DON'T THEY?
I HATE THIS MODEL. NOTHING FIT RIGHT, THE INSTRUCTIONS WERE INCOMPREHENSIBLE. THE DECALS RIPPED, THE PAINT SLOPPED, AND THE GLUE GOT EVERYWHERE.
WHAT A DISASTER. SIX BUCKS COMPLETELY DOWN THE DRAIN.
I CAN'T THINK OF AN AFTERNOON I'VE ENJOYED LESS. WHAT A WASTE. WHAT A DUMB HOBBY.
OF COURSE, WITH THIS FOR PRACTICE, I'LL BET WE COULD DO GREAT ON ANOTHER MODEL!
LET'S GET ONE OF THOSE CLIPPER SHIPS WITH ALL THE RIGGINGS.

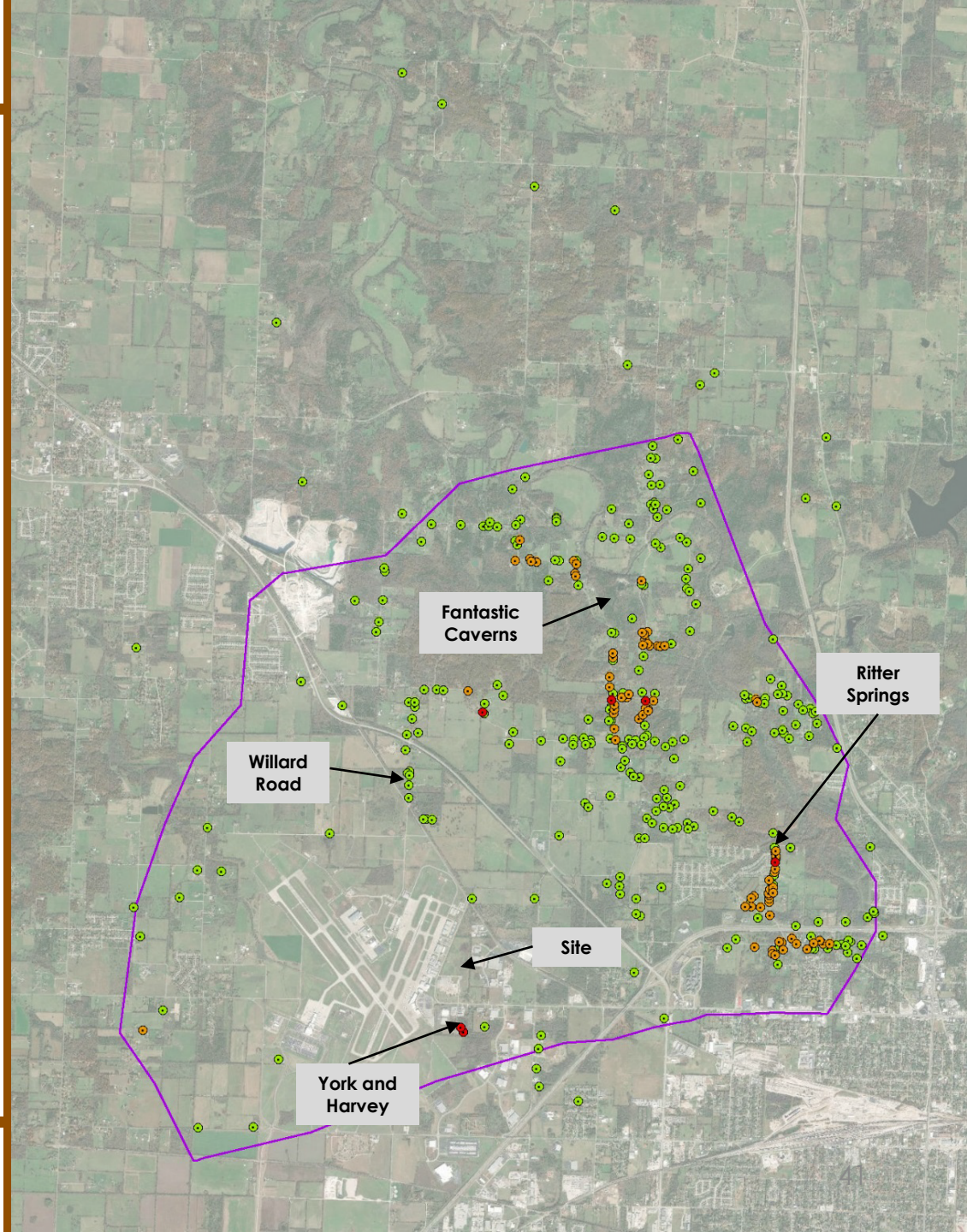
Conceptual Model

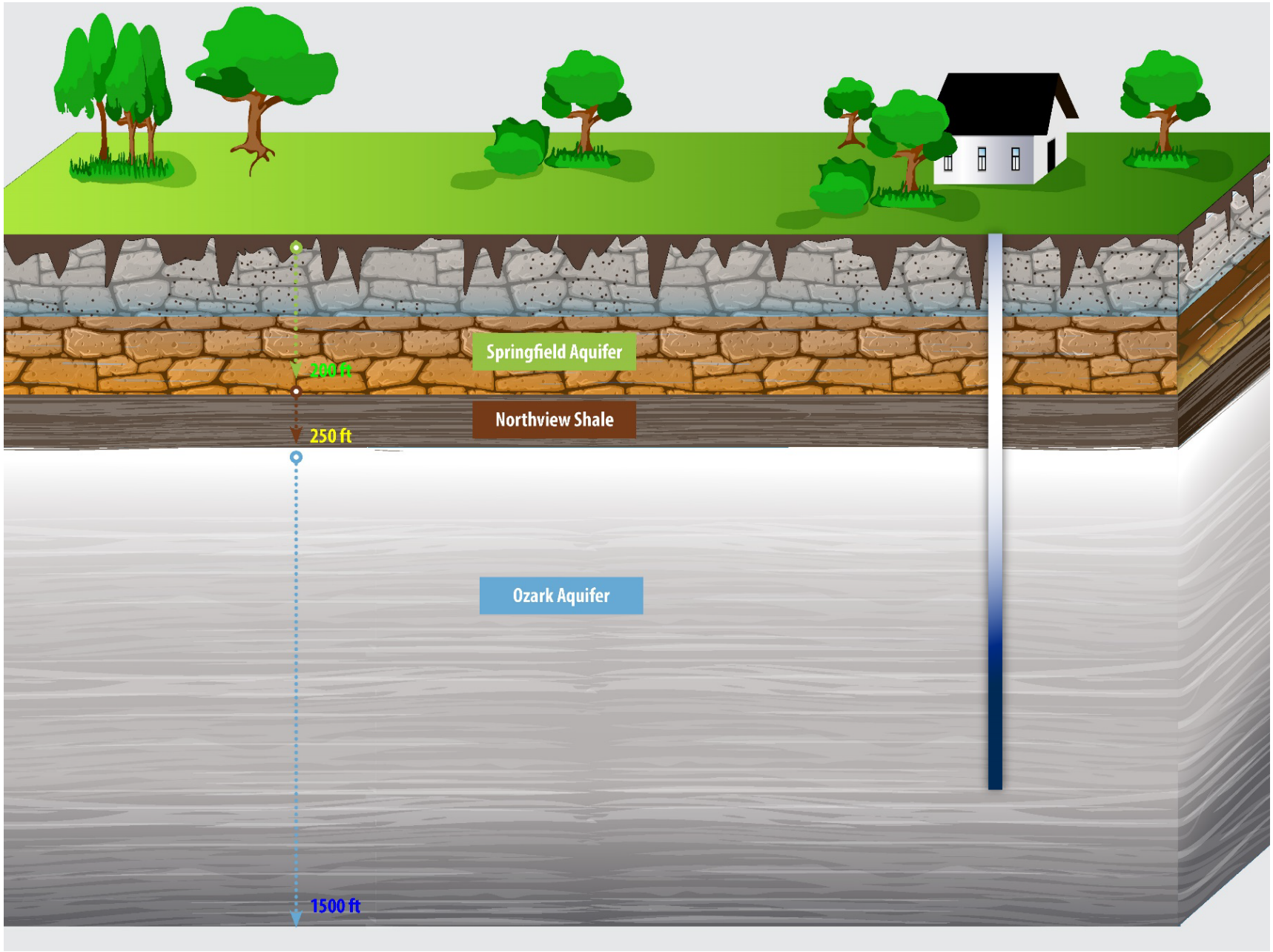


Data Objective (DO) Flow Chart

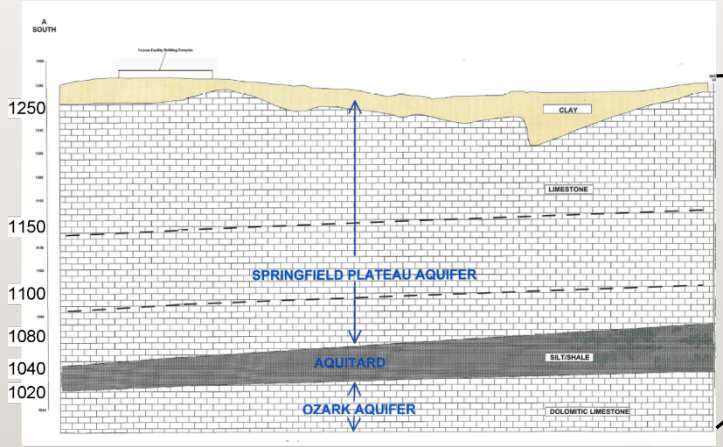


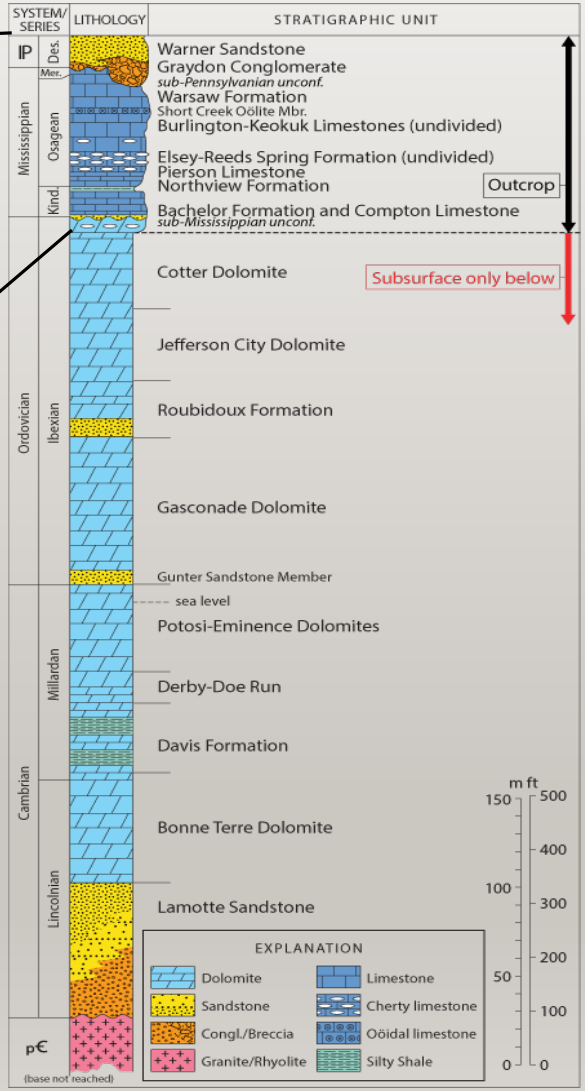
Overview of Key Site Features



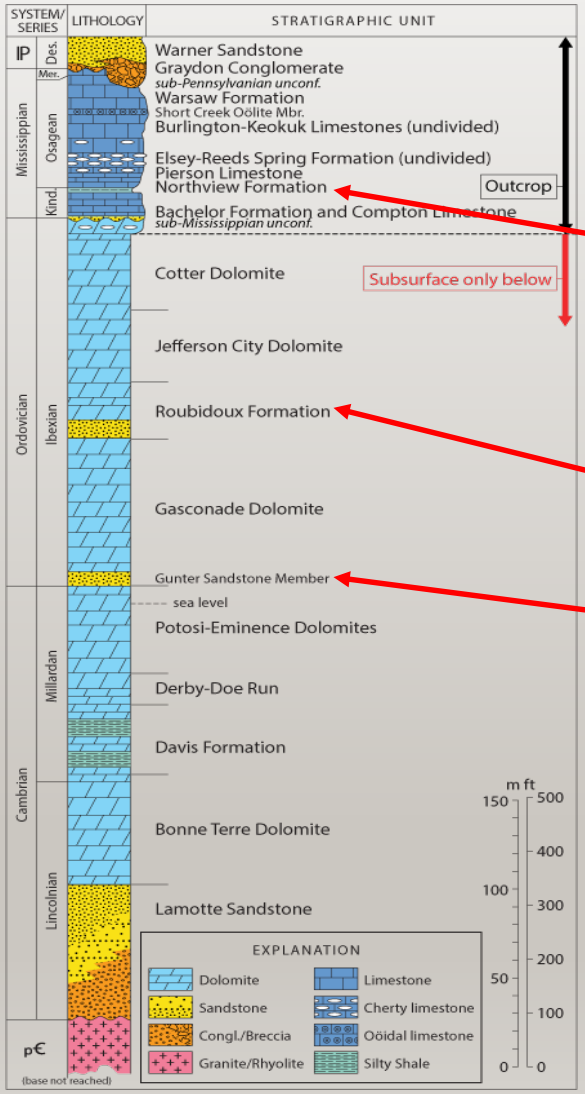

Springfield Aquifer
200 ft
Northview Shale
250 ft
Ozark Aquifer
1500 ft

Geology



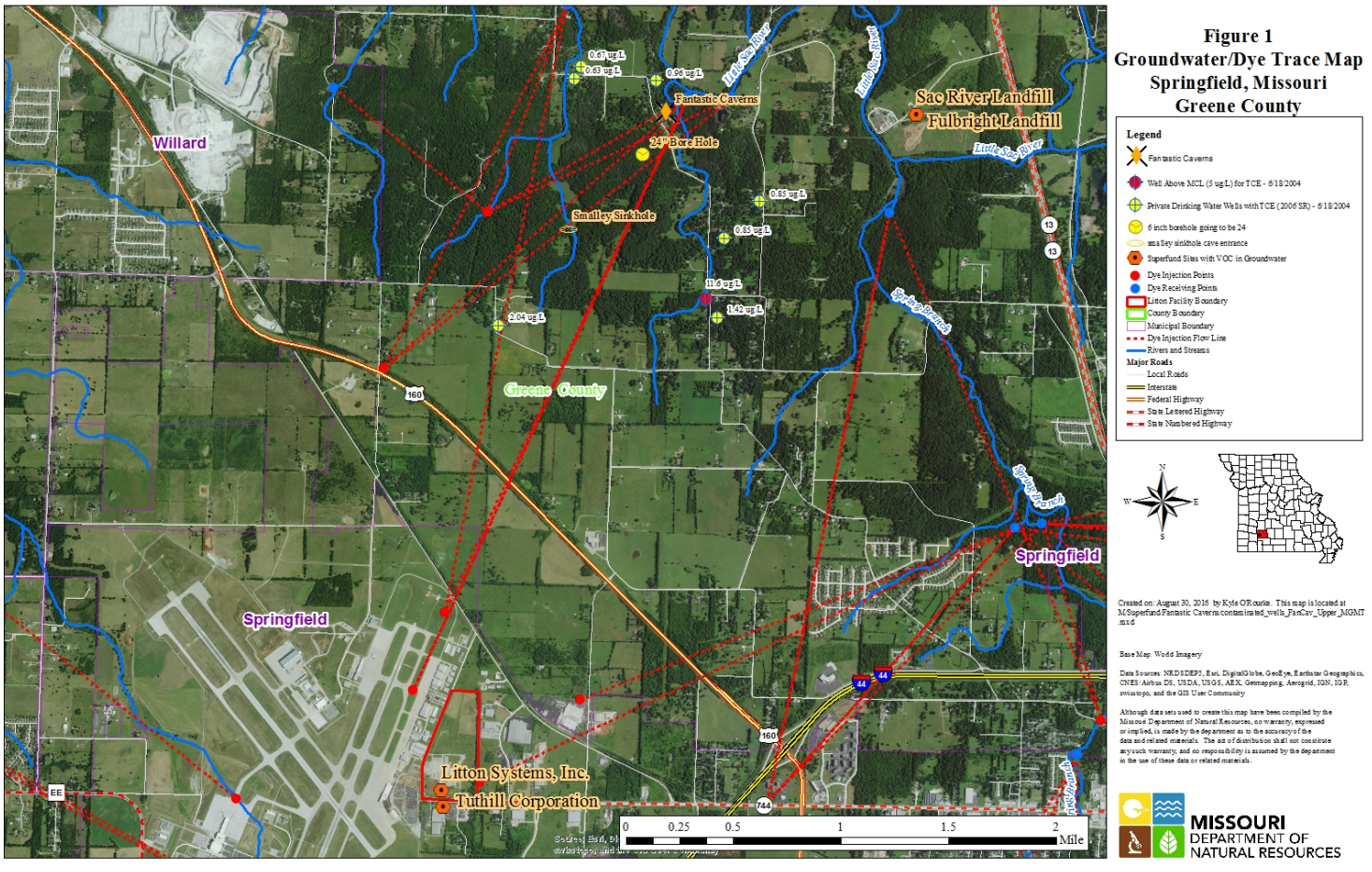


Geology – Well IW-01

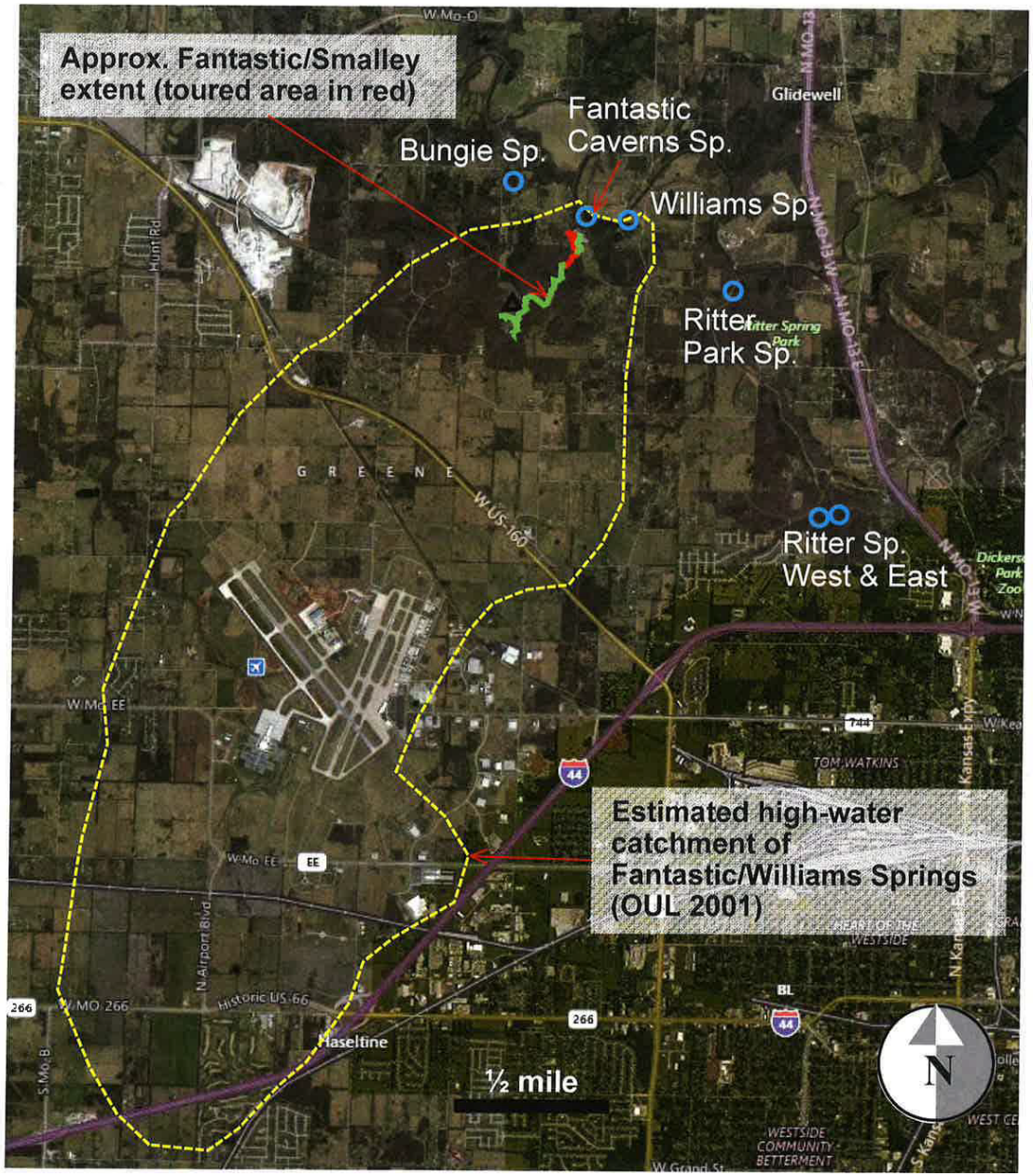



```
Log #:022630
Top  Base Name
  20   280 MISSISSIPPIAN SYSTEM
  20   240 OSAGEAN SERIES
  20   130 KEOKUK-BURLINGTON LS. UNDIFF
 130   195 ELSEY-REEDS SPRING UNDIFF.
 195   240 PIERSON LIMESTONE
 240   280 KINDERHOOKIAN SERIES
 240   265 NORTHVIEW SHALE
 265   280 COMPTON LIMESTONE
 280  1165 ORDOVICIAN SYSTEM
 280  1165 CANADIAN SERIES
 280   435 COTTER DOLOMITE
 435   660 JEFFERSON CITY DOLOMITE
 605   620 "QUARRY LEDGE"
 660   835 ROUBIDOUX FORMATION
 835  1165 GASCONADE DOLOMITE
 835   870 UPPER GASCONADE DOLOMITE
 870  1125 LOWER GASCONADE DOLOMITE
1125  1165 GUNTER SANDSTONE MEMBER
1165  1390 CAMBRIAN SYSTEM
1165  1390 UPPER CAMBRIAN SERIES
1165  1390 EMINENCE DOLOMITE
1390     0 TOTAL DEPTH
```

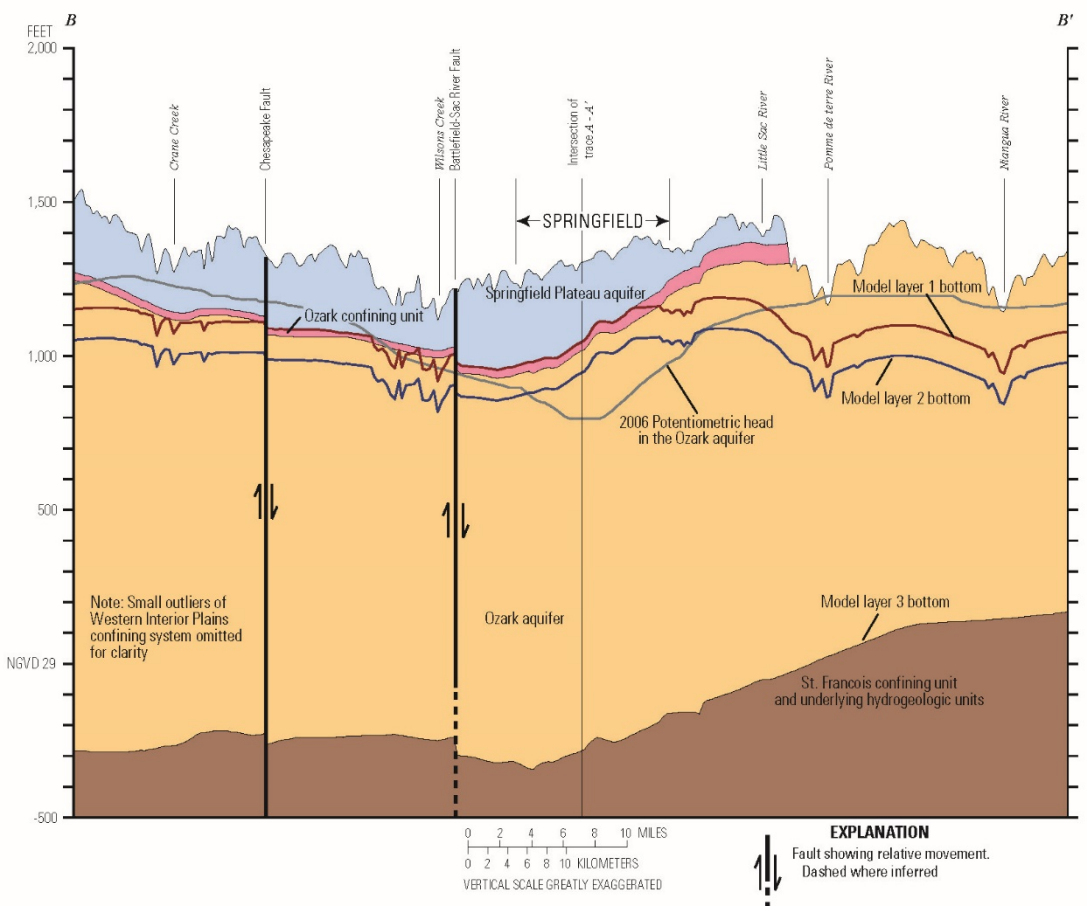
Dye Study Map



Fantastic Caverns Catchment

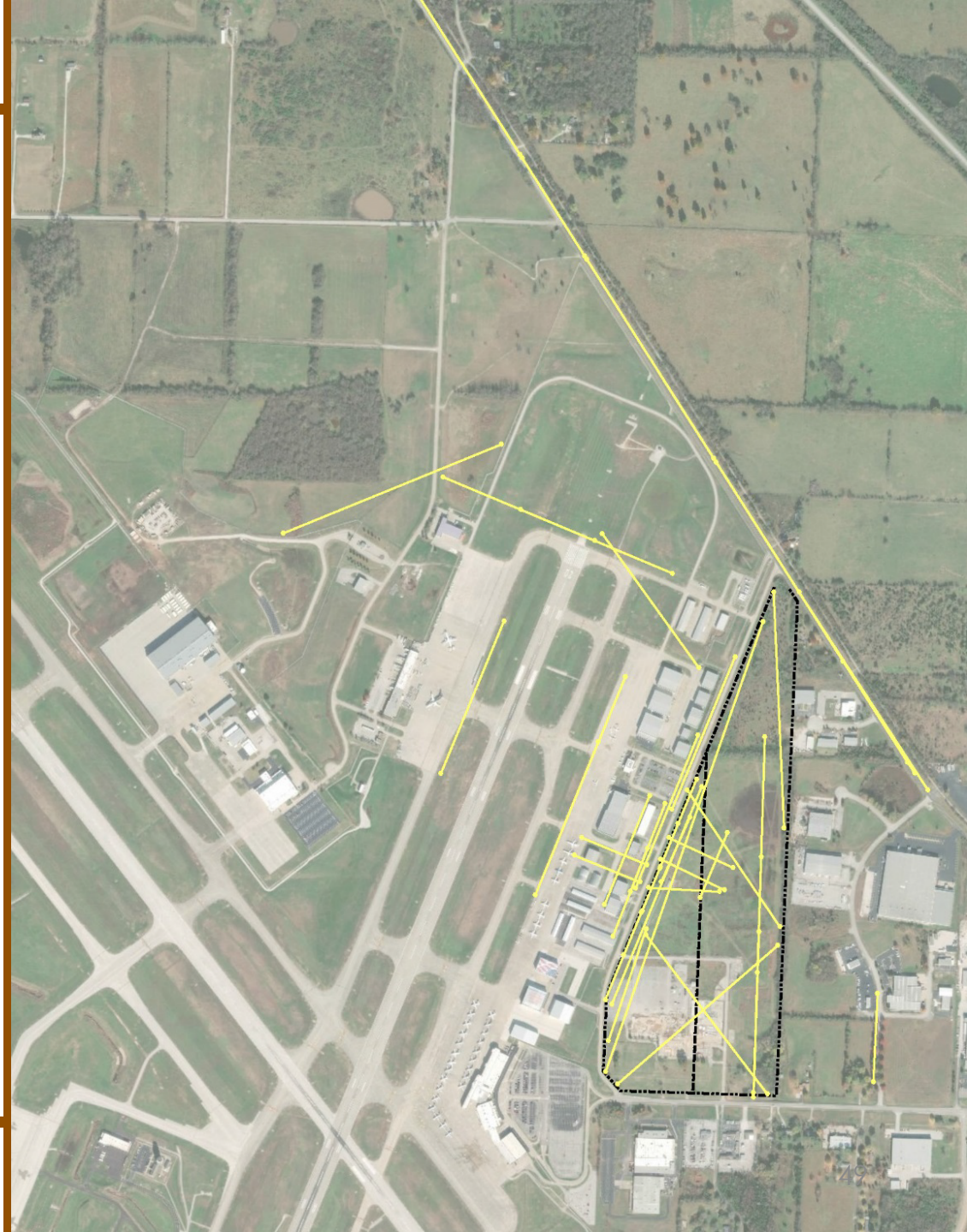


Ozark Aquifer Overdraft

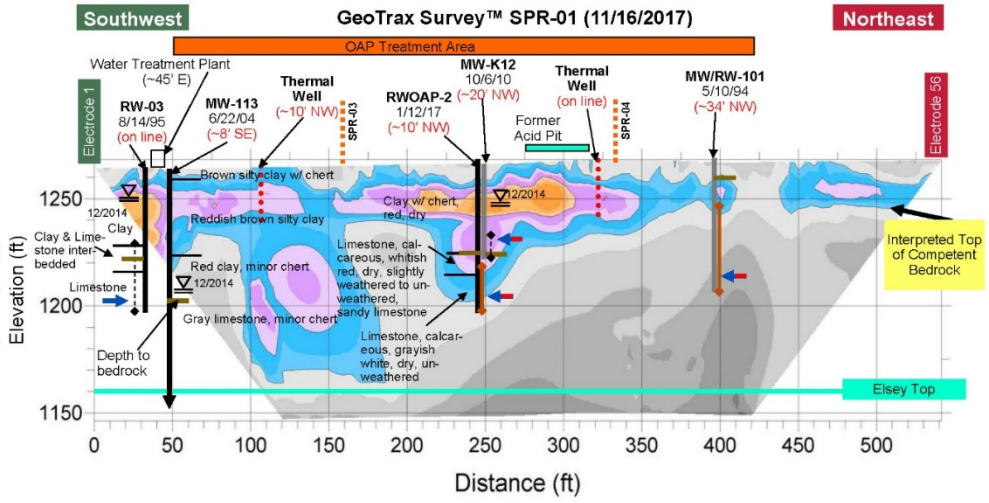


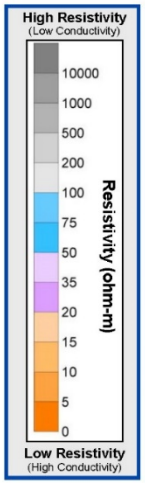
Conceptual Site Model - Surface Geophysical Data

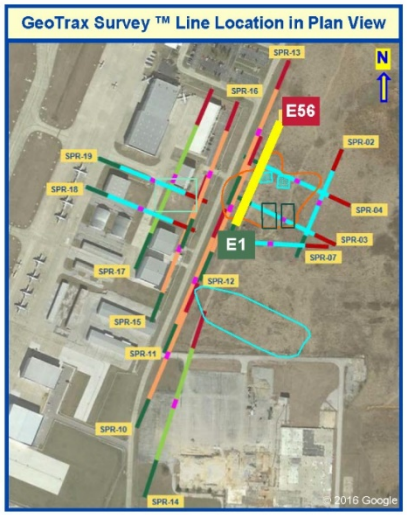
Surface Geophysics



Phase 1 of Surface Geophysics







Groundwater Sample Results

Well		RW-03	MW-113	RWOAP-2	MW-K12	*MW-K12	MW/RW-101	MW/RW-101
Sample Date		12/8/16	12/8/16	3/4/17	12/15/15	12/15/16	12/10/15	12/14/16
Parameters (µg/L)	Standards (µg/L)							
TCE	5	0.5	**6,200**	**570,000**	4,800	48	410,000	NS
cis-1,2-DCE	70	0	**9,100**	**12,000**	6,000	2	25,000	
trans-1,2-DCE	100	0	46	0	0	0	0	
1,1,1 TCA	200	0	140	**800 J**	84	5	39,000	
1,1 DCA	5	**5.3**	**160**	0	110	9	770	
Copper mg/L	1.3 mg/L	0.0022	0.0051	**2.8**	0.03	0.059	45	

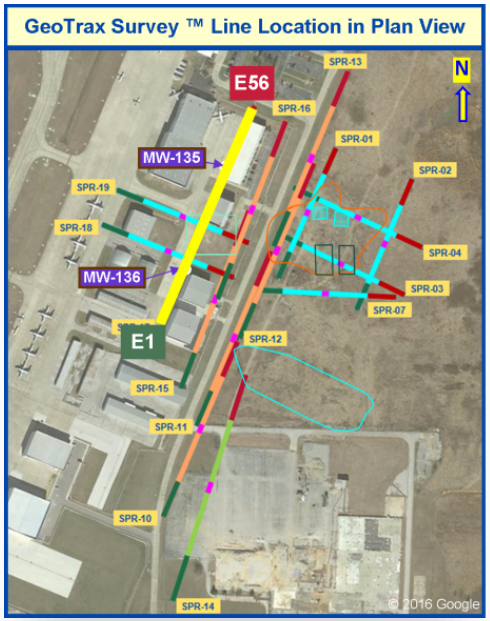
*BTEX compounds were detected in the groundwater sample collected from MW-K12 (12/15/16) at concentrations below regulatory standards.

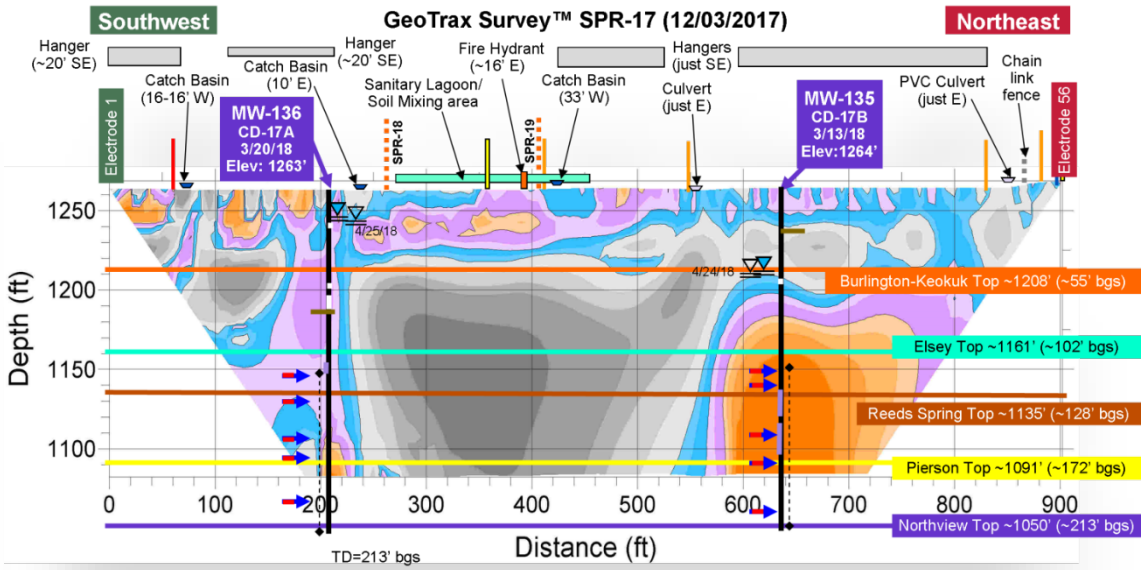
Groundwater MNA Sample Results

Well		RW-03	MW-113	RWOAP-	MW-K12	MW/RW-
Sample Date		12/8/16	12/8/16	2016	2016	2016
Parameters	Units					
Ethane	µg/L	9.7	4	NS	NS	NS
Ethylene	µg/L	0	19			
Methane	µg/L	7,600	12			
Tot. Org. Carbon	mg/L	7.5	2.6			
Iron	mg/L	6	0.5			

Groundwater Quality Sample Results

Well		RW-03	MW-113	RWOAP -2	MW-K12	MWRW-101
Sample Date		12/8/16	12/8/16	2016	12/8/16	2016
Parameters	Units					
Temperature	°F	53.11	59.59	NS	62.49	NS
ORP	volts	-0.05	-0.078		-0.12	
pH	SU	6.93	11.51		6.65	
DO	mg/L	0.77	5.53		0	
EC	mS/cm	0.91	1.36		3.13	

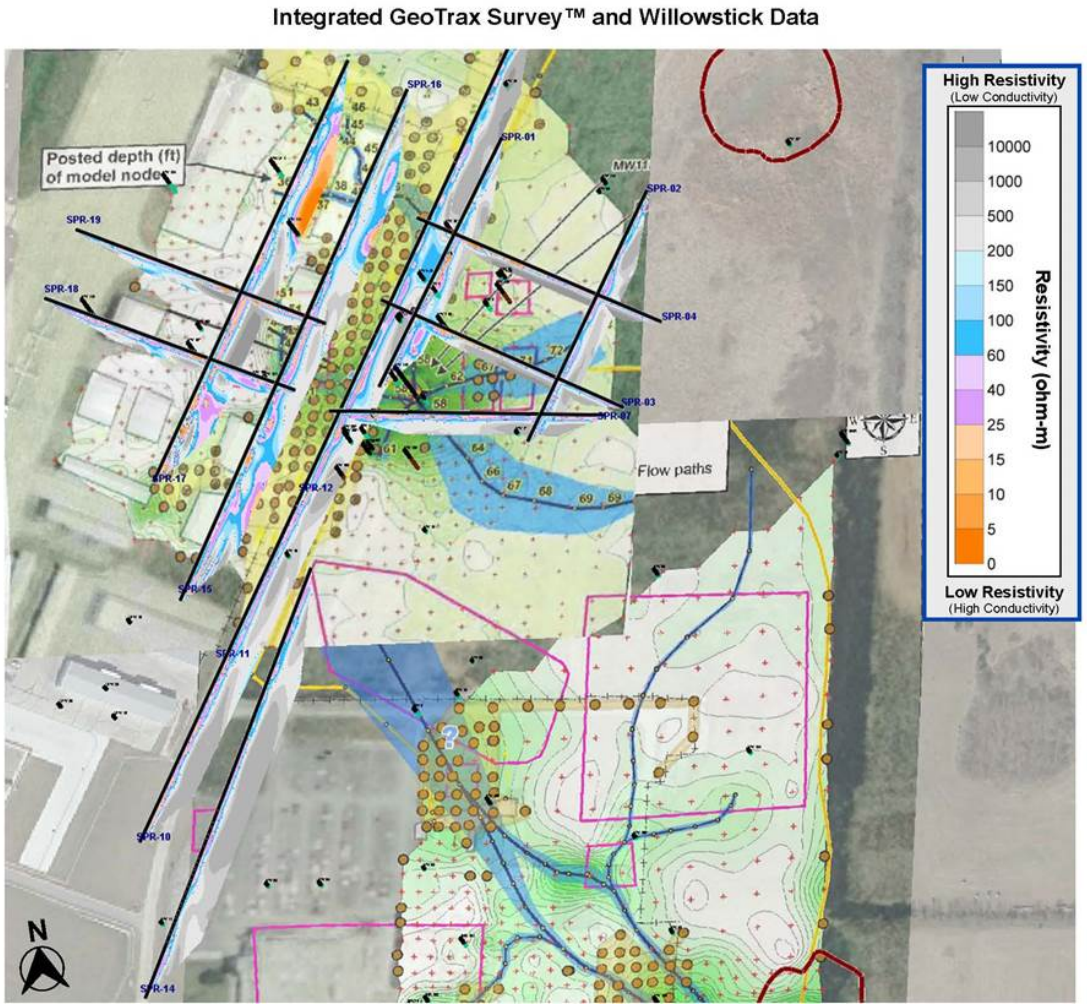




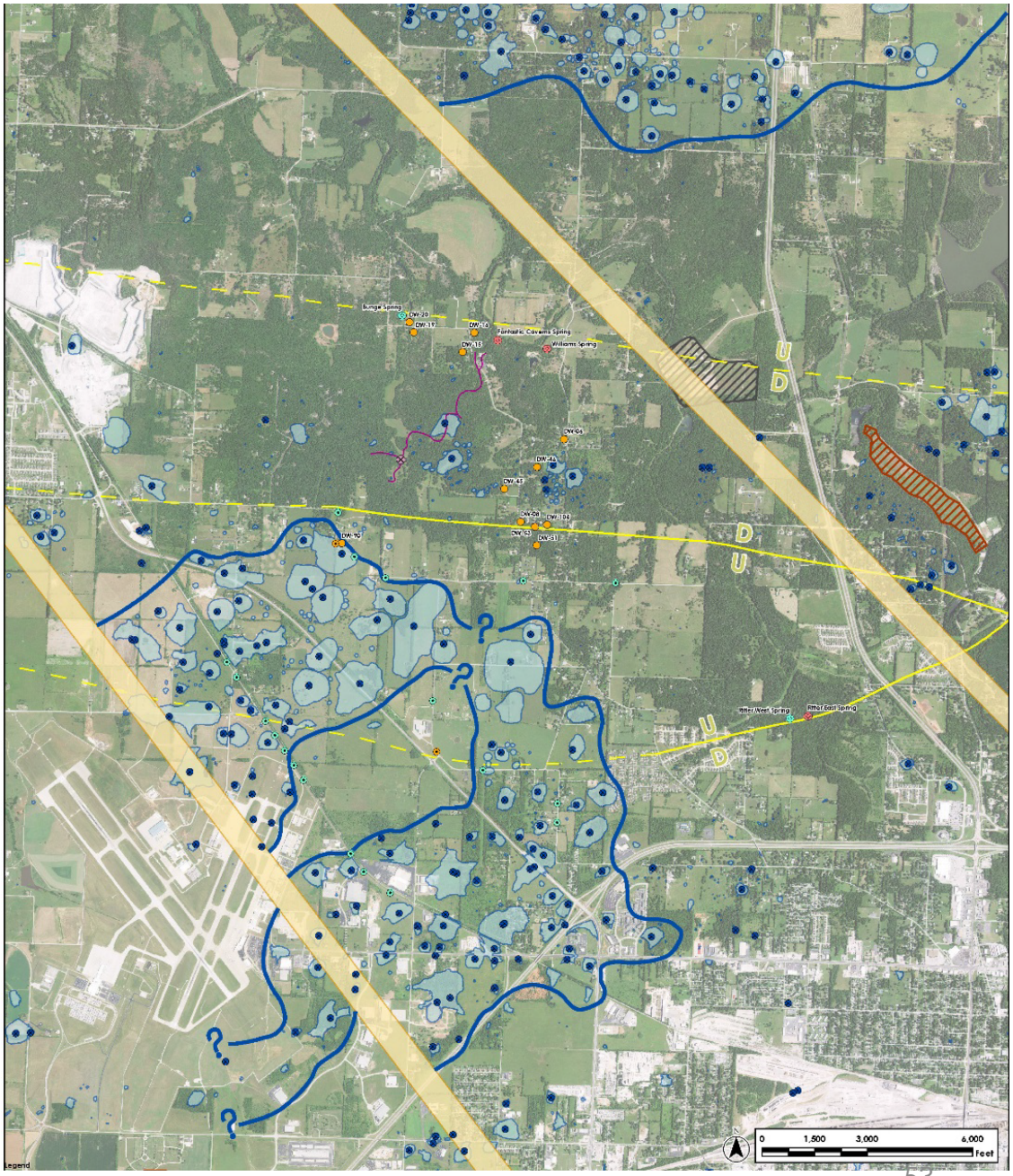
Phase 2 of Surface Geophysics

Groundwater Sample Results											
Well		MW-136					MW-135				
Sample Date		4/25/18					4/24/18				
Parameters (µg/L)	Standards (µg/L)	115'	131'	153'	167'	194'	114'	124'	156'	171'	204'
TCE	5	**39000**	**35000**	**35000**	**34000**	**34000**	**4300**	**4200**	**3700**	**3200**	**3200**
cis-1,2 DCE	70	**1400**	**240**	**240**	**250**	**240**	**660**	**740**	**530**	**610**	**580**
Vinyl Chloride	2	0	0	0	0	0	0	**5.7 J**	0	**6.6 J**	**5.4 J**
trans-1,2 DCE	100	0	0	0	0	0	5.7 J	8 J	0	6.4 J	5.9 J
1,1,1 TCA	200	**730**	140	140	150	130	89	110	81	120	120
1,1 DCA	5	**120**	0	0	0	0	**25**	**29**	**24**	**33**	**31**
1,1-DCE	6	**4000**	**720**	**680**	**710**	**710**	**480**	**540**	**420**	**590**	**550**
1,2-Dichloropropane	5	**460**	**94**	**85**	**91**	**92**	**56**	**60**	**49**	**54**	**53**
1,4-Dioxane	61	**80**	**80 F1**	**83**	**78**	**84**	**330**	**340**	**300**	**290**	**300**

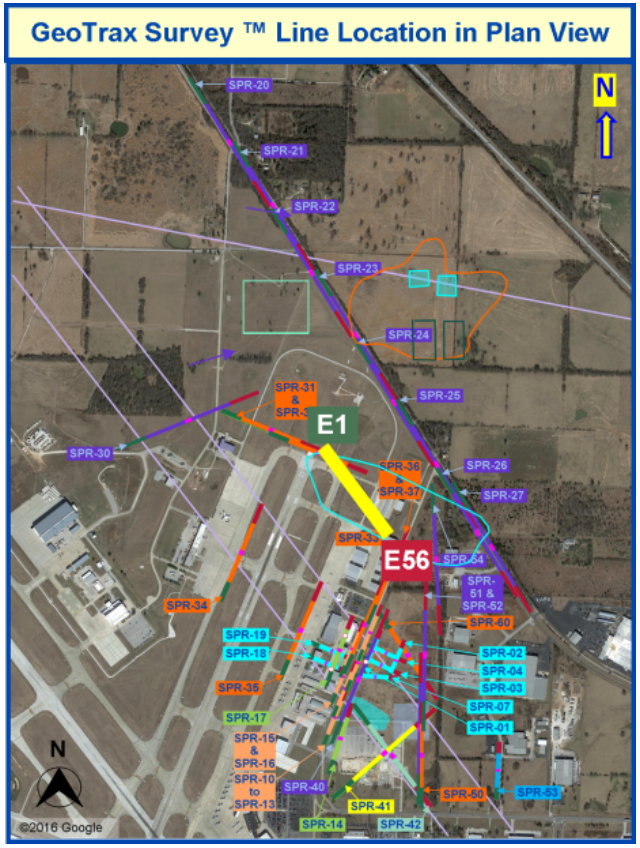
Integrating Geophysical Data Sets

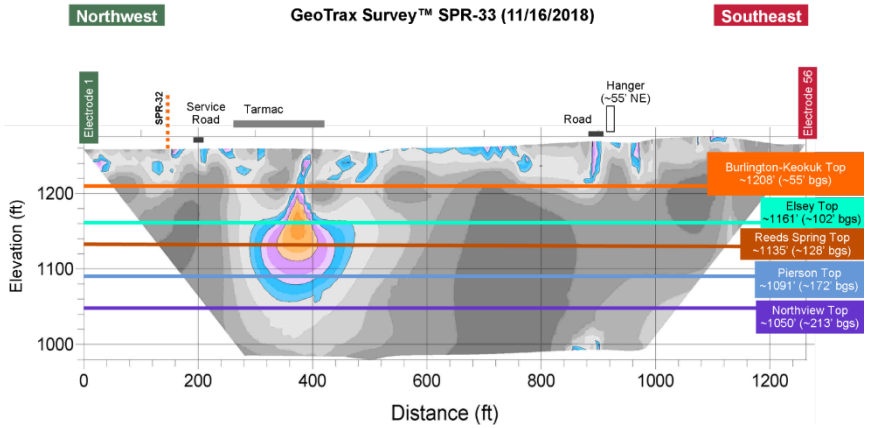


CSM Following Phase 2 of Surface Geophysics

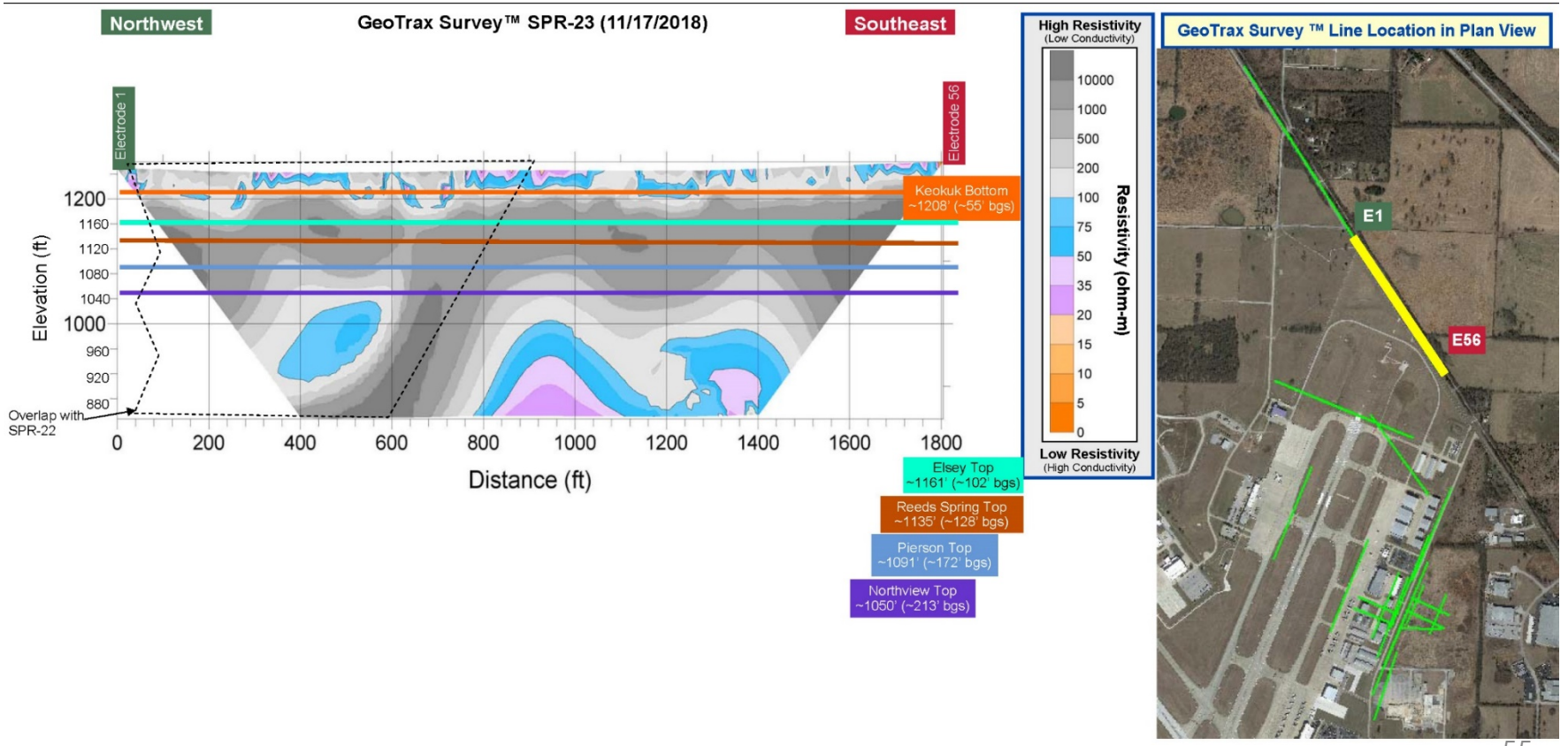


Phase 3 of Surface Geophysics

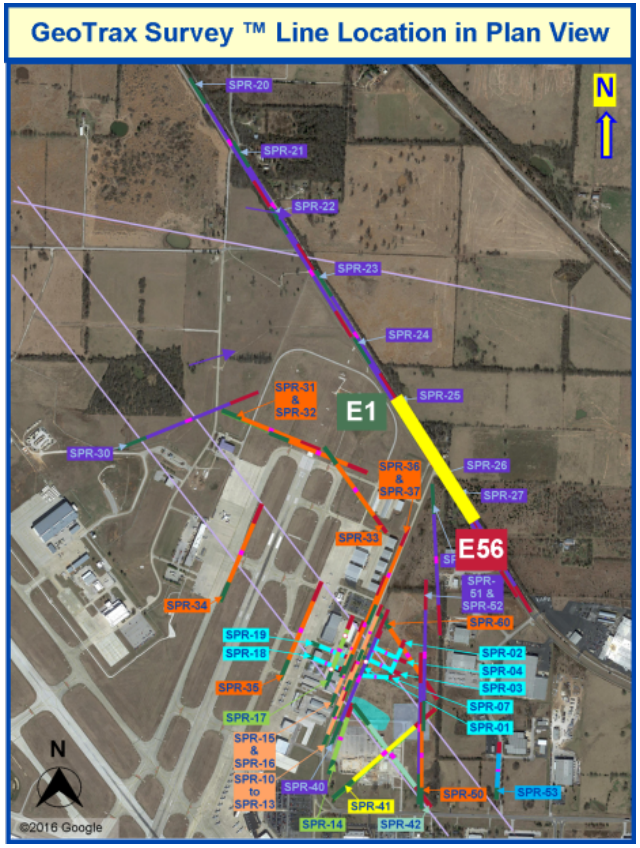


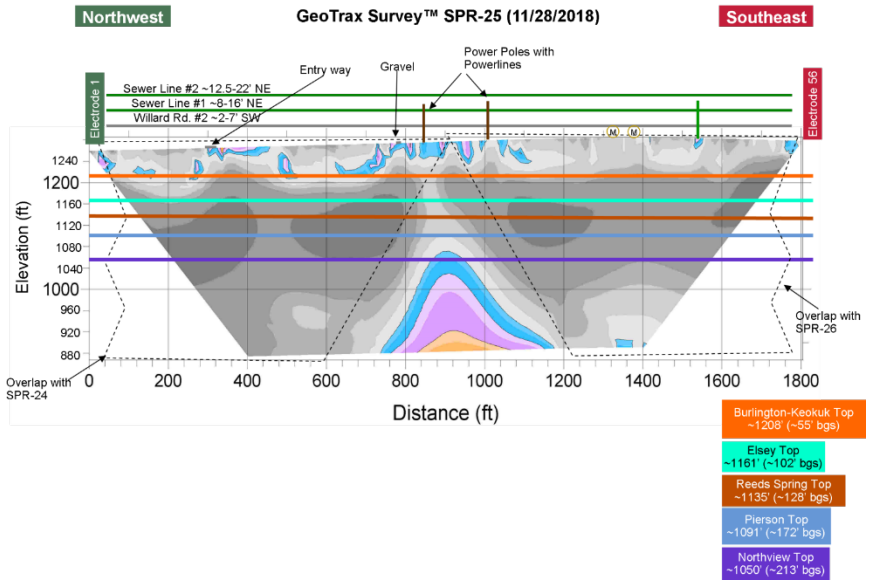


Phase 3 of Surface Geophysics

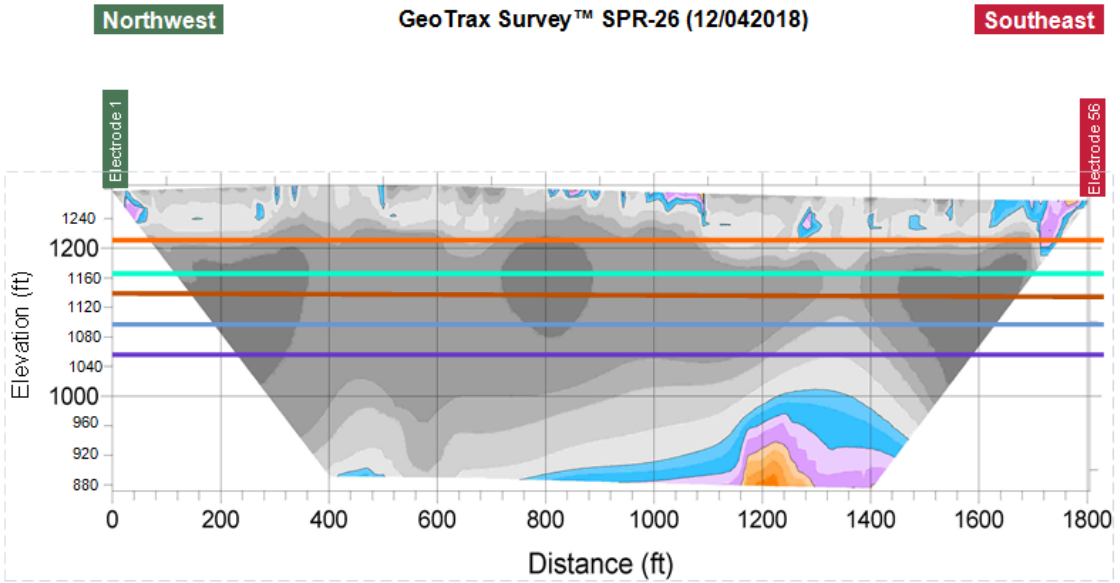


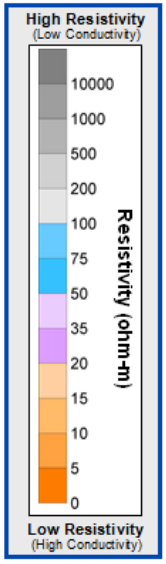
Phase 3 of Surface Geophysics

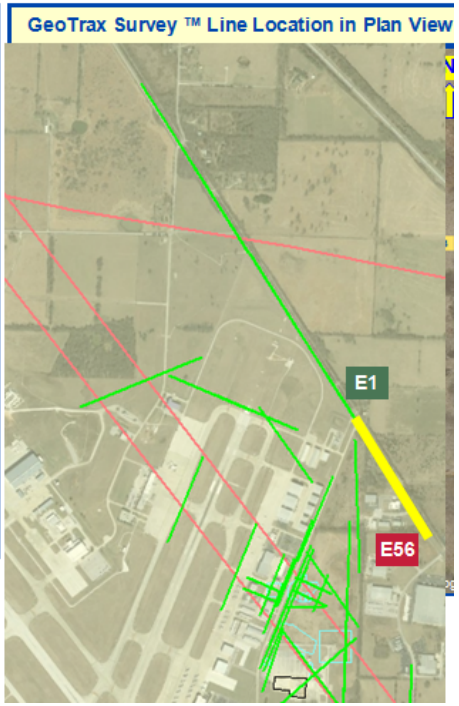




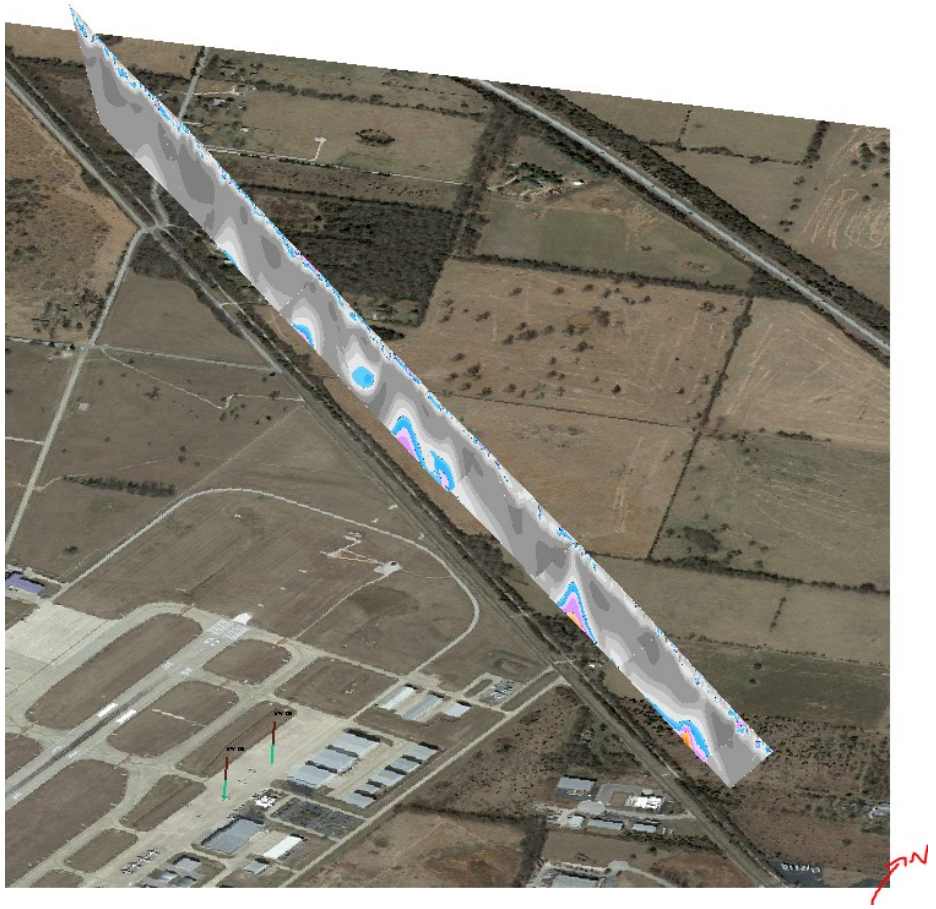
Phase 3 of Surface Geophysics



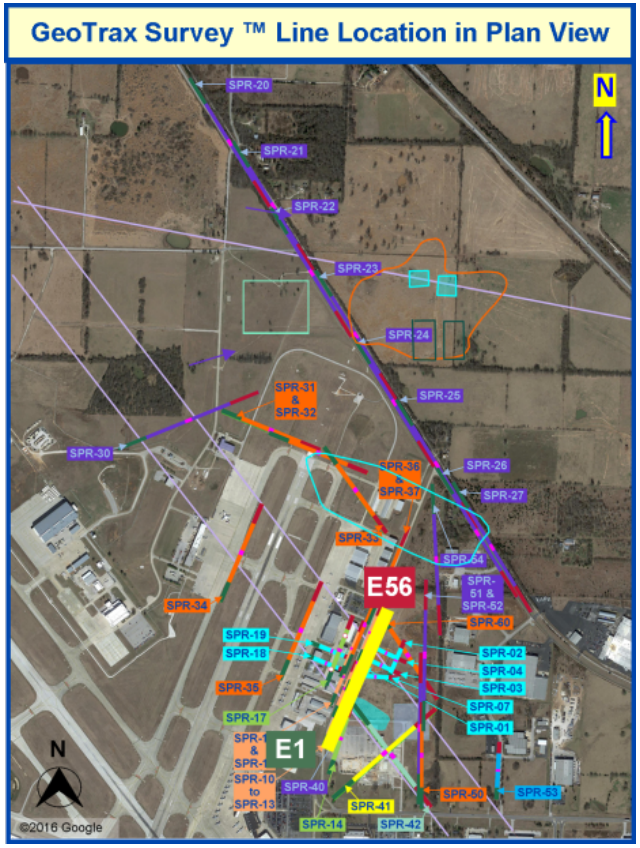


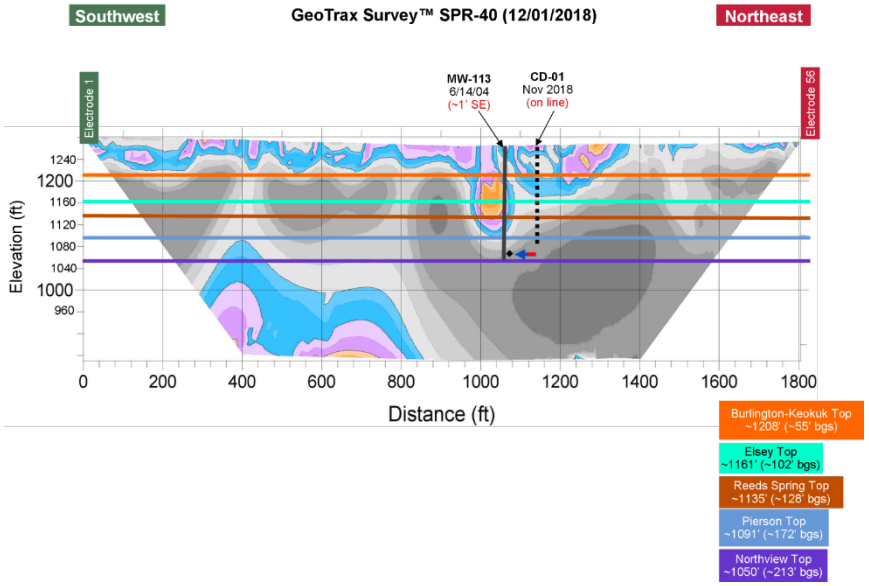


Phase 3 of Surface Geophysics

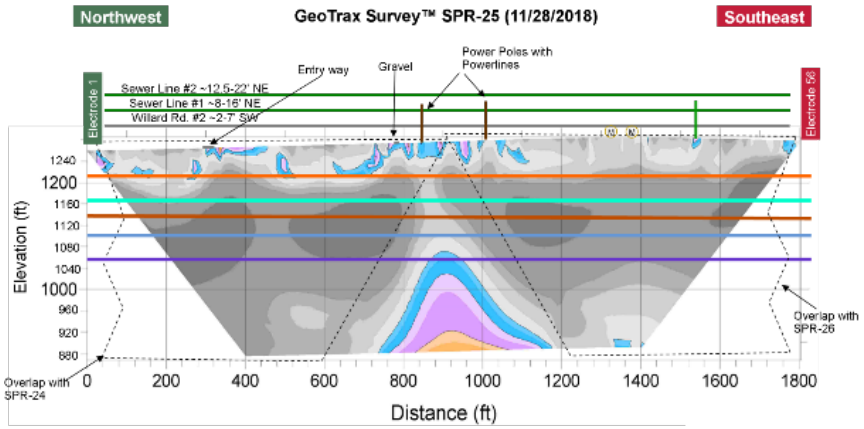


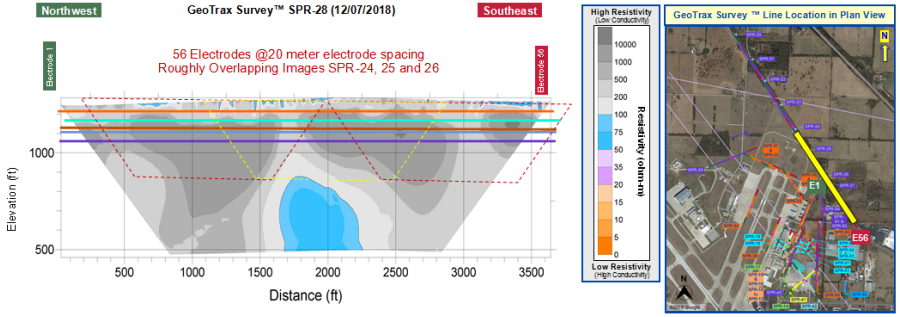
Phase 3 of Surface Geophysics



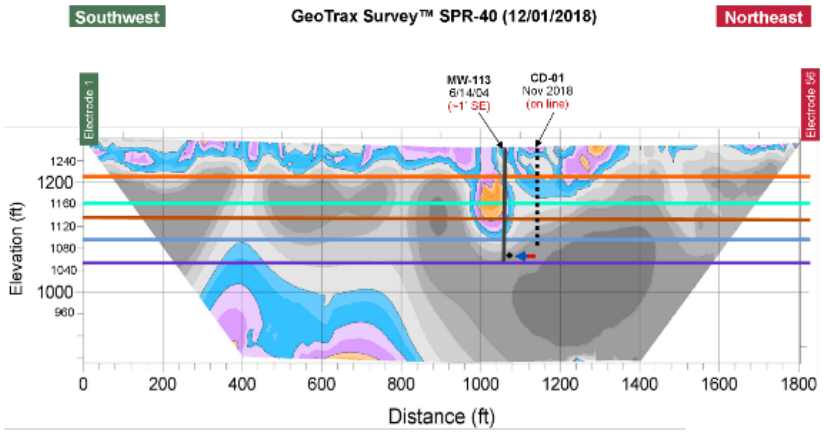


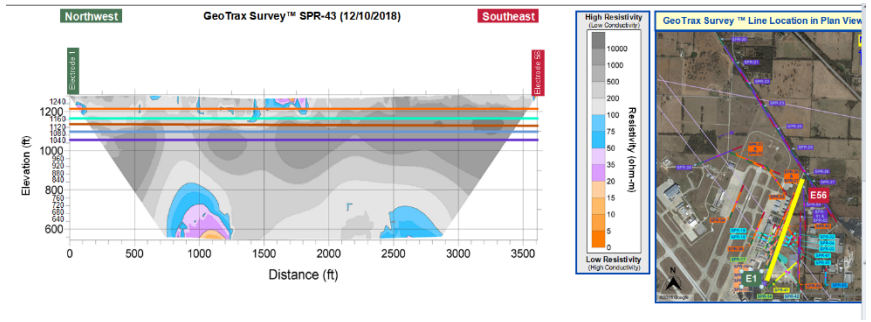
Phase 3 of Surface Geophysics



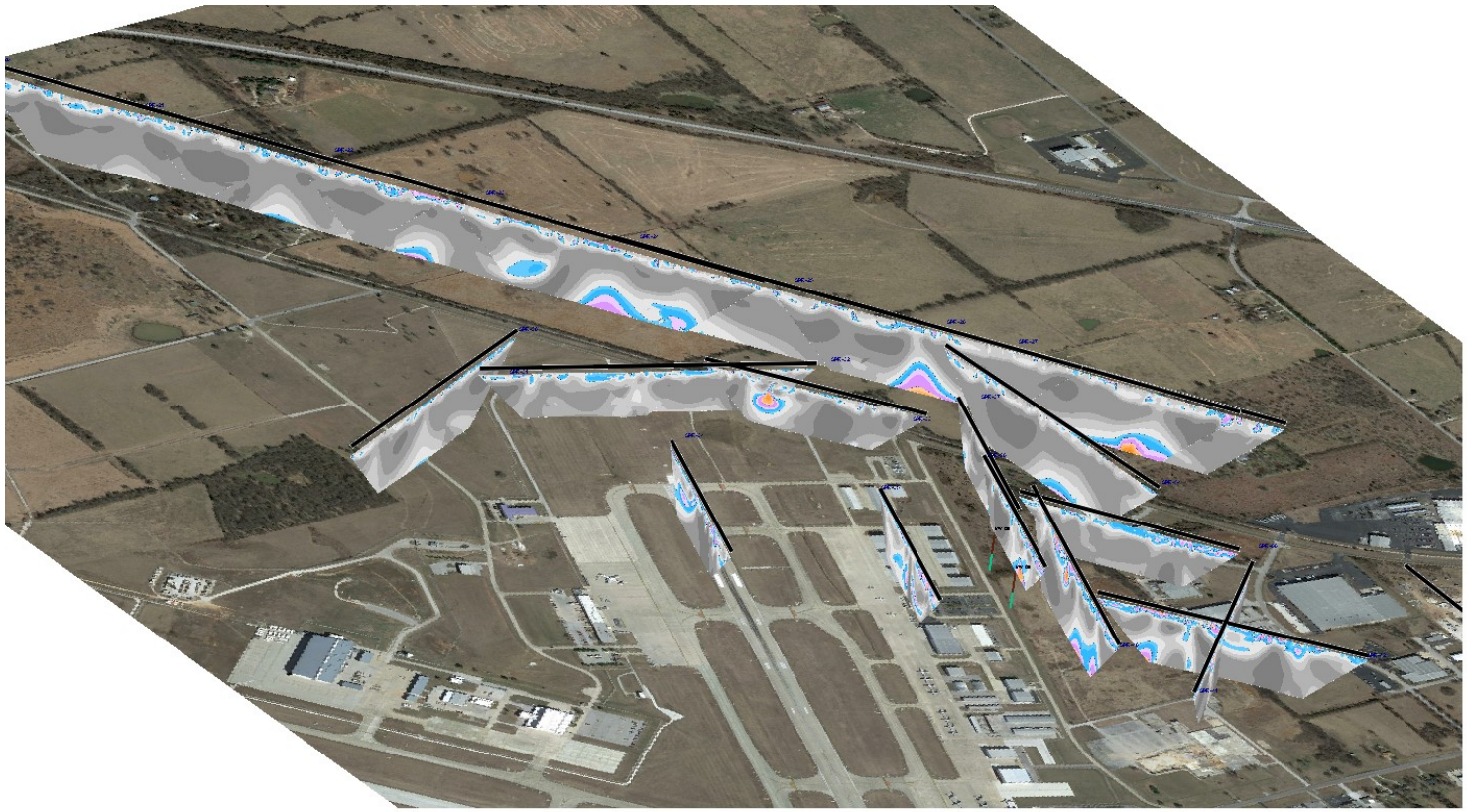


Phase 3 of Surface Geophysics

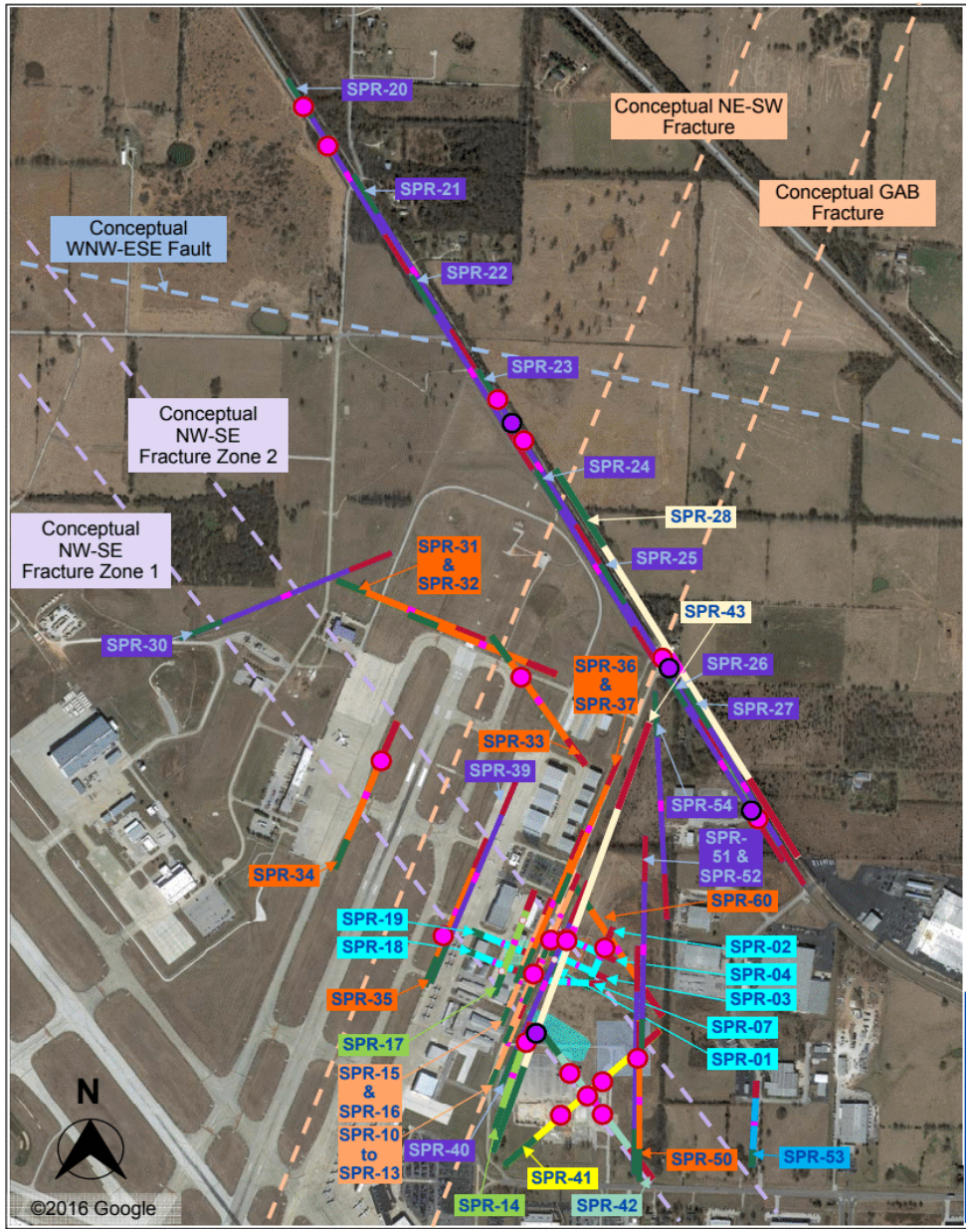




Phase 3 of Surface Geophysics



Fracture and Fault Features?



Phase 3 of Surface Geophysics

Summary of Surface Geophysics

- Conceptual Model of Northwest-Southeast Trending Fracture Zone appears Accurate
- Potential Northeast Trending Faults and/or Fractures also Observed in Ozark Aquifer
- Conductive Features in Burlington-Keokuk Limestone appear to Extend to the North along the Western Extent of Willard Road Assessment Area
- Conductive Features Observed Below the Northview Formation Aquitard in the Ozark Aquifer
    - On the Site
    - Along Willard Road
- Installation and Sampling of Wells in Key Areas is Needed to Better Understand what the Conductive Features Represent

Conceptual Site Model - Downhole Geophysics

Downhole Geophysics – Ozark Aquifer (MWO-01, -02, -05, -07, and -08)

- Heat Pulse, Electromagnetics (EM), Temperature, Conductivity
- MWO-01 and -02 are 1,500 ft deep
- MWO-07 and -0-8 are 900 ft deep
- Zones of "inflow" and "outflow" observed
- Flow from 300 to 400 FT BGS is Minimal
- Flow from 400 to 650 FT BGS is "Average"
- Strongest Inflow observed in Roubidoux and Upper Glasconade – 650 to 850 FT BGS

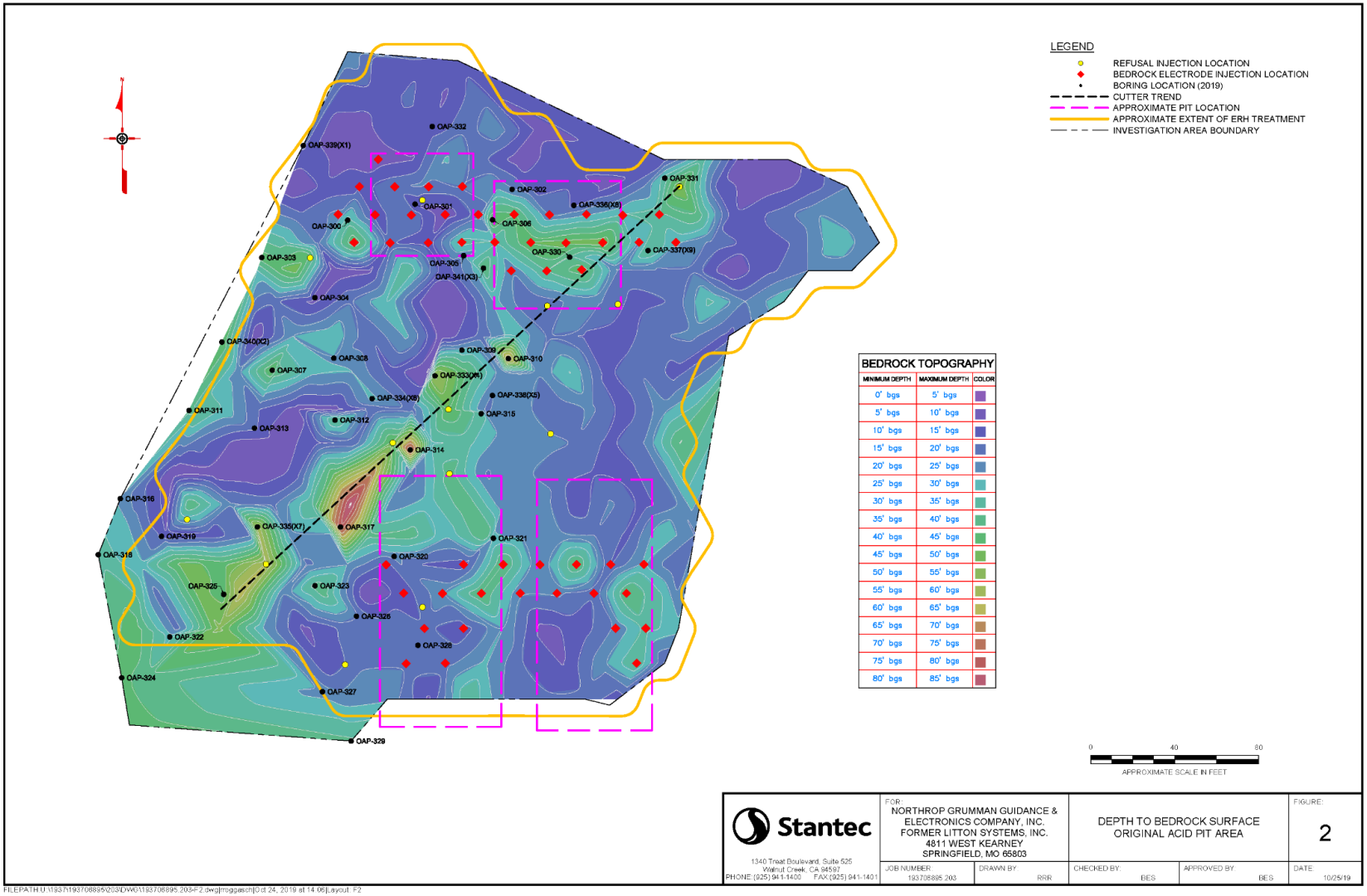
Conceptual Site Model – VOCs in Springfield Rock Fractures

VOCs in Springfield Rock Fractures at the OAP (µg/L)

	RWOAP-1	RWOAP-2	MW-101
"Screen" Interval (FT BGS)	(28-75)	(48-70)	(21-59)
TCE	930,000	350,000	320,000
1,1,1-TCA	2,100	2,200	26,000
cis-1,2-DCE	13,000	27,000	9,300
trans-1,2-DCE	< 1,000	< 1,000	< 1,000
1,1-DCE	47,000	18,000	13,000
vinyl chloride	490	< 500	< 500
1,4-dioxane	30,000	5,400	7,600

Wells are Screened in Burlington-Keokuk Limestone

Much Higher Concentrations of Constituents than Currently Pumped at MW-129


LEGEND
REFUSAL INJECTION LOCATION
BEDROCK ELECTRODE INJECTION LOCATION
BORING LOCATION (2019)
CUTTER TREND
APPROXIMATE PIT LOCATION
APPROXIMATE EXTENT OF ERH TREATMENT
INVESTIGATION AREA BOUNDARY
OAP-332
OAP-339(X1)
OAP-331
OAP-302
OAP-301
OAP-336(X8)
OAP-300
OAP-306
OAP-303
OAP-330
OAP-337(X9)
OAP-305
OAP-341(X3)
OAP-304
OAP-340(X2)
OAP-309
OAP-310
OAP-308
OAP-307
OAP-333(X6)
OAP-334(X8)
OAP-336(X5)
OAP-311
OAP-315
OAP-313
OAP-312
OAP-314
OAP-316
OAP-335(X7)
OAP-317
OAP-321
OAP-319
OAP-318
OAP-320
OAP-325
OAP-323
OAP-326
OAP-322
OAP-328
OAP-324
OAP-327
OAP-329
BEDROCK TOPOGRAPHY
MINIMUM DEPTH
MAXIMUM DEPTH
COLOR
0' bgs
5' bgs
5' bgs
10' bgs
10' bgs
15' bgs
15' bgs
20' bgs
20' bgs
25' bgs
25' bgs
30' bgs
30' bgs
35' bgs
35' bgs
40' bgs
40' bgs
45' bgs
45' bgs
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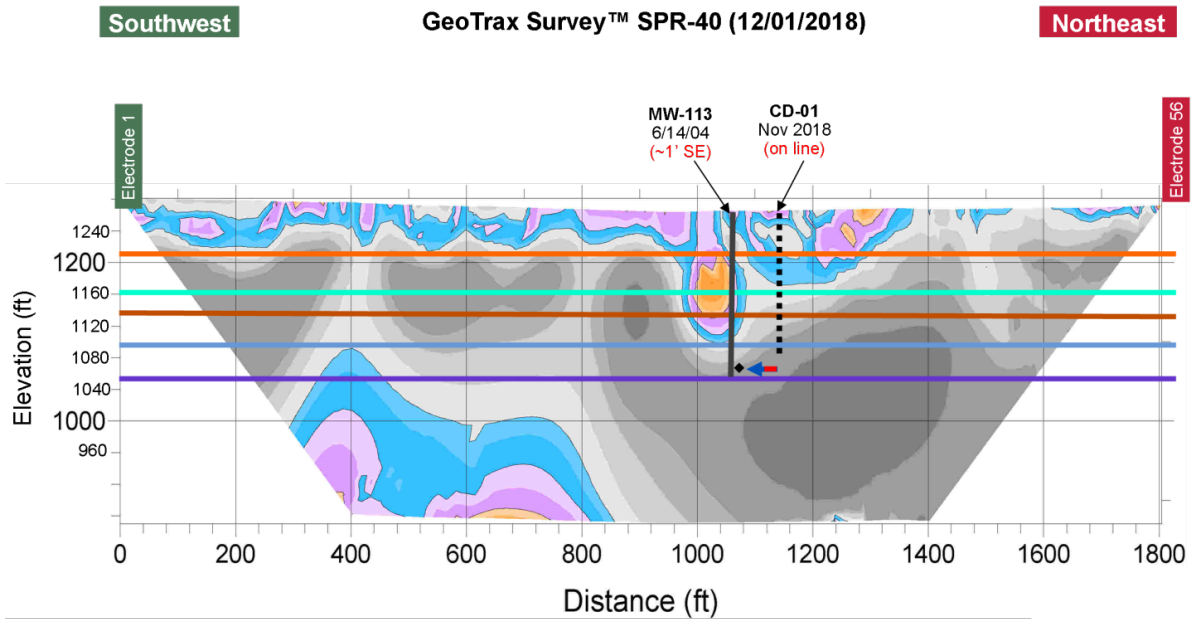
50' bgs
55' bgs
55' bgs
60' bgs
60' bgs
65' bgs
65' bgs
70' bgs
70' bgs
75' bgs
75' bgs
80' bgs
80' bgs
85' bgs
0
40
80
APPROXIMATE SCALE IN FEET
Stantec
1340 Treat Boulevard, Suite 525
Walnut Creek, CA 94597
PHONE: (925) 941-1400 FAX (925) 941-1401
FOR:
NORTHROP GRUMMAN GUIDANCE & ELECTRONICS COMPANY, INC.
FORMER LITTON SYSTEMS, INC.
4811 WEST KEARNEY
SPRINGFIELD, MO 65803
DEPTH TO BEDROCK SURFACE
ORIGINAL ACID PIT AREA
FIGURE:
2
JOB NUMBER: 193708895.203
DRAWN BY: RRR
CHECKED BY: BES
APPROVED BY: BES
DATE: 10/25/19
FILEPATH:U:\193\193708895\203\DWG\193708895.203-F2.dwg|roggasch|Oct 24, 2019 at 14:06|Layout: F2

MW-113



Groundwater Sample Results

Well		RW-03	MW-113	RWOAP-2	MW-K12	*MW-K12	MW/RW-101	MW/RW-101
Sample Date		12/8/16	12/8/16	3/4/17	12/15/15	12/15/16	12/10/15	12/14/16
Parameters (µg/L)	Standards (µg/L)							
TCE	5	0.5	**6,200**	**570,000**	4,800	48	410,000	NS
cis-1,2-DCE	70	0	**9,100**	**12,000**	6,000	2	25,000	
trans-1,2-DCE	100	0	46	0	0	0	0	
1,1,1 TCA	200	0	140	**800 J**	84	5	39,000	
1,1 DCA	5	**5.3**	**160**	0	110	9	770	
Copper mg/L	1.3 mg/L	0.0022	0.0051	**2.8**	0.03	0.059	45	

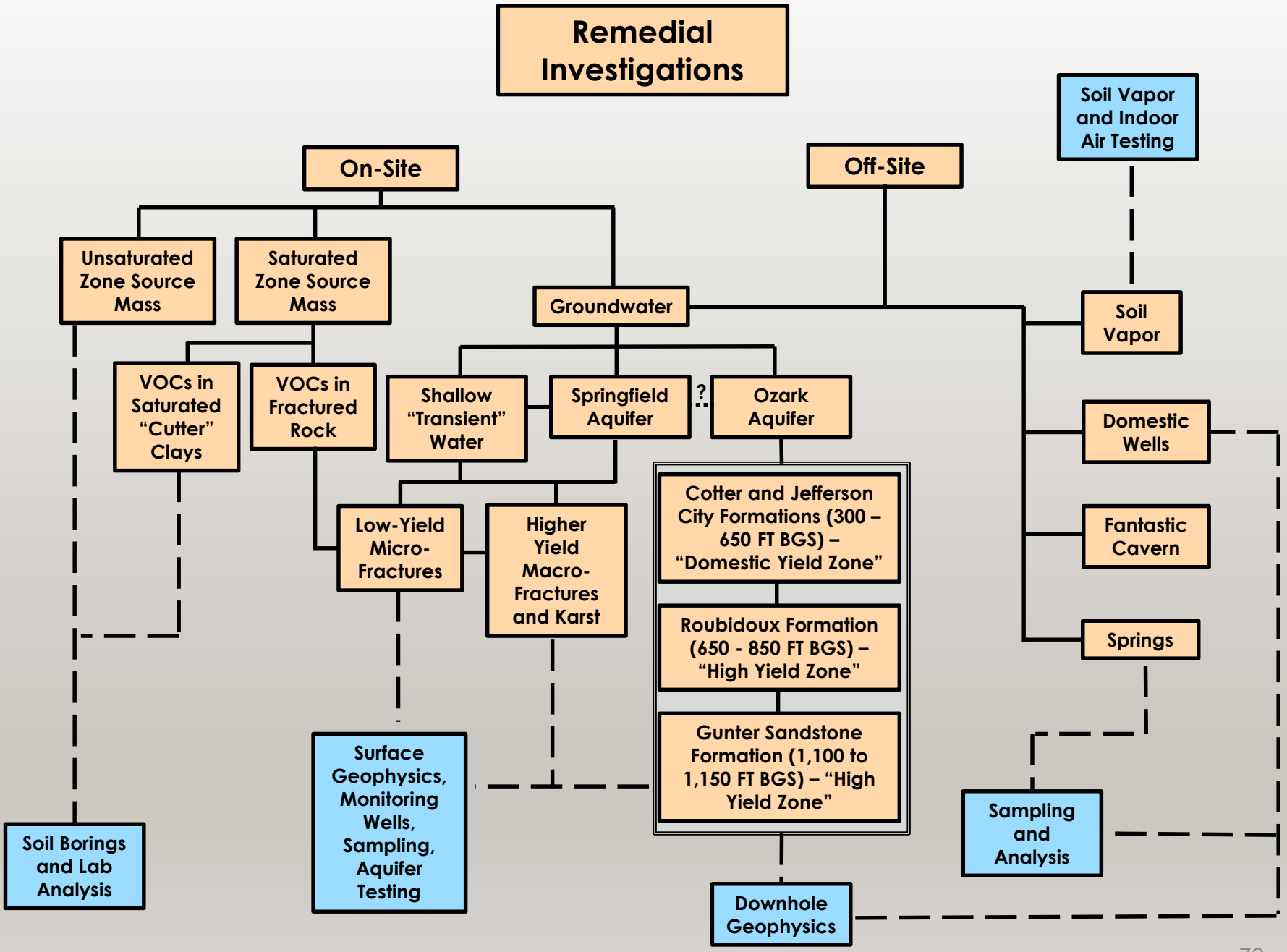
*BTEX compounds were detected in the groundwater sample collected from MW-K12 (12/15/16) at concentrations below regulatory standards.

Groundwater MNA Sample Results

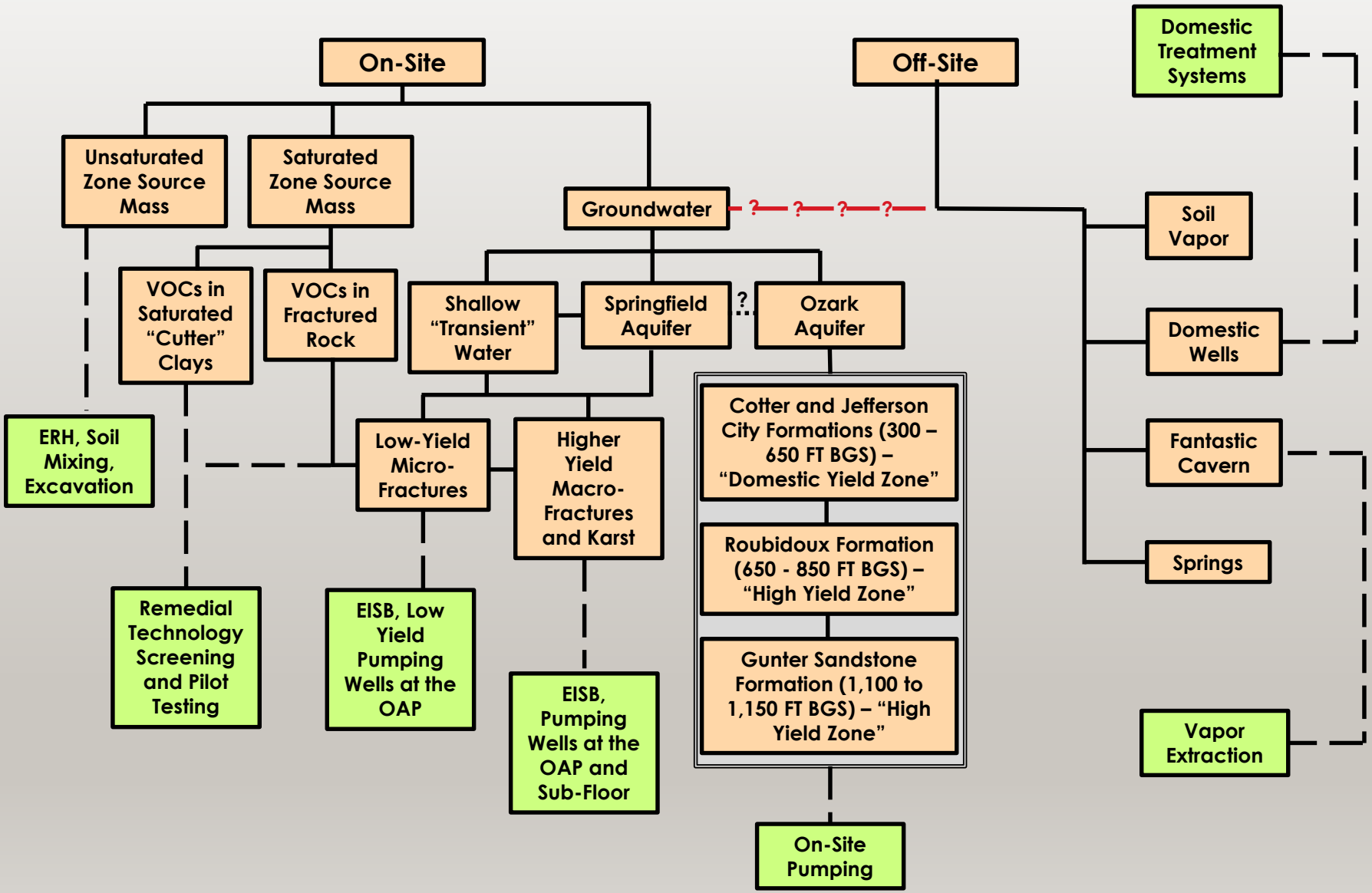
Well		RW-03	MW-113	RWOAP-	MW-K12	MW/RW-
Sample Date		12/8/16	12/8/16	2016	2016	2016
Parameters	Units					
Ethane	µg/L	9.7	4	NS	NS	NS
Ethylene	µg/L	0	19			
Methane	µg/L	7,600	12			
Tot. Org. Carbon	mg/L	7.5	2.6			
Iron	mg/L	6	0.5			

Groundwater Quality Sample Results

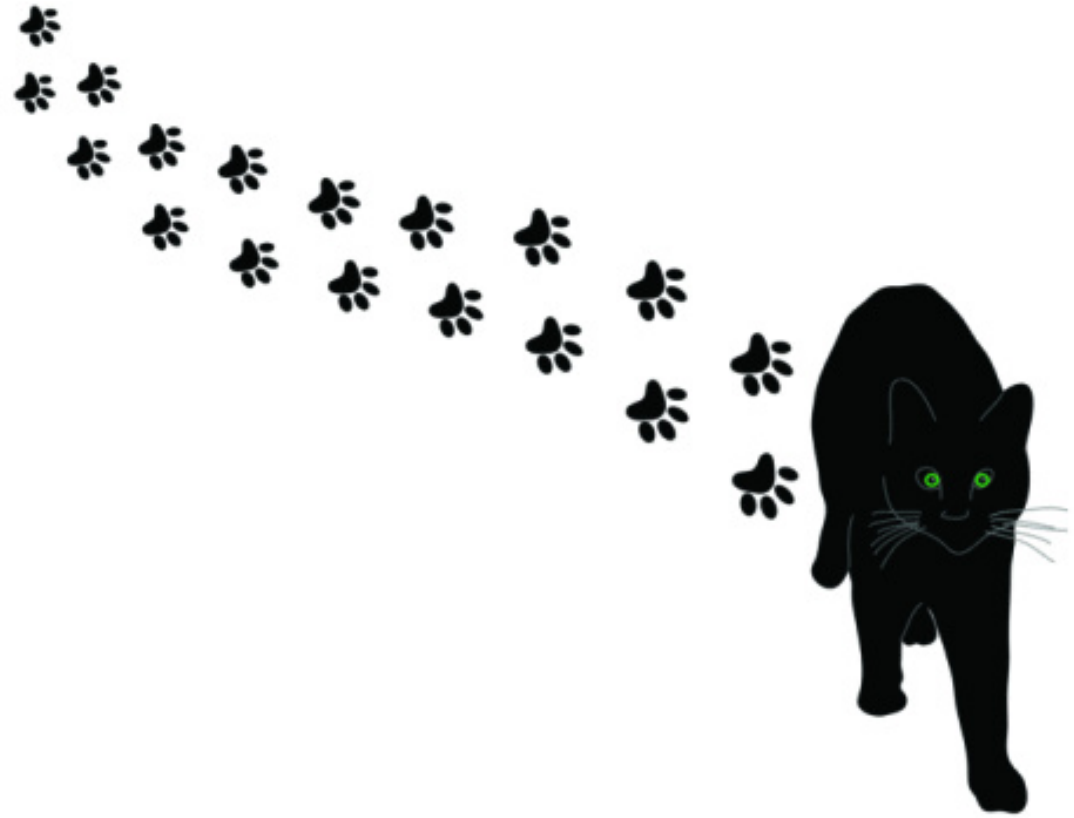
Well		RW-03	MW-113	RWOAP -2	MW-K12	MWRW-101
Sample Date		12/8/16	12/8/16	2016	12/8/16	2016
Parameters	*Units*					
Temperature	°F	53.11	59.59	NS	62.49	NS
ORP	volts	-0.05	-0.078		-0.12	
pH	SU	6.93	11.51		6.65	
DO	mg/L	0.77	5.53		0	
EC	mS/cm	0.91	1.36		3.13	


Remedial Investigations
On-Site
Off-Site
Soil Vapor and Indoor Air Testing
Unsaturated Zone Source Mass
Saturated Zone Source Mass
Groundwater
Soil Vapor
VOCs in Saturated "Cutter" Clays
VOCs in Fractured Rock
Shallow "Transient" Water
Springfield Aquifer
?
Ozark Aquifer
Domestic Wells
Low-Yield Micro-Fractures
Higher Yield Macro-Fractures and Karst
Cotter and Jefferson City Formations (300 – 650 FT BGS) – "Domestic Yield Zone"
Fantastic Cavern
Roubidoux Formation (650 - 850 FT BGS) – "High Yield Zone"
Springs
Gunter Sandstone Formation (1,100 to 1,150 FT BGS) – "High Yield Zone"
Soil Borings and Lab Analysis
Surface Geophysics, Monitoring Wells, Sampling, Aquifer Testing
Sampling and Analysis
Downhole Geophysics

Interim Actions



Let's "Paws" and Recap the Things We Already Know



What We Know

Groundwater and Springs

- TCE is present on the Site in the Springfield and Ozark aquifers
- TCE is present on the airport in the Springfield and Ozark aquifers
- TCE is present in domestic wells to the North, East, and South of the site
- TCE is present in springs to the North and East of the site

What We Know

Site Operations

- TCE was discharged at the OAP, Sanitary Lagoon, NAP, and Sub-Floor Areas
- VOCs remain in saturated clays and fractured bedrock
  - OAP and Sub-Floor

What We Know

Geology and Hydrology

- Shallow limestone geology at the site and surrounding areas is characterized by karst dissolution features (upper 100 feet bgs)
- Tracer tests indicate rapid groundwater movement from the Site to springs to the north (Fantastic Caverns) and east (Ritter Springs)
- Faults off-set geologic units and have pronounced but undefined hydraulic affects
- The Ozark aquifer is over-drafted and there is a downward gradient from the Springfield aquifer

What We Know

Geology and Hydrology

- Faulting may have "broken" the aquitard at undefined locations
- Drilling and surface geophysics data indicate likely Northwest and Northeast trending fracture/fault features on the Site and surrounding areas
- There is a "regional" east-west series of fault structures that create a "horst and graben" geologic fabric

What We Know

Soil Vapor

- TCE is present in soil vapor to the west of the Site
- TCE is present in soil vapor and "cave air" at Fantastic Caverns
- Shallow soil vapor sampling on a "regional scale" suggests clay overburden provides a "blanket" against potential for indoor air vapor intrusion

What We Know

Investigation Tools

- Surface geophysics (resistivity) can be used to map both karst and fractured bedrock "flow zones" to depth of at least 700 feet bgs
- Downhole geophysics can identify zones of preferential groundwater flow under both static and dynamic conditions
- Drilling is costly and open boreholes have limitations for data collection

What We Know

Groundwater

- There are many groundwater "flow zones" in the Ozark aquifer – Fracture Flow
- Groundwater flows into and out of the borehole in wells screened across multiple flow zones
- Most domestic wells are screened in the upper 400 to 500 feet bgs – Jefferson City Formation
- Very productive groundwater flow zones are present on the Site in the Roubidoux and Upper Glasconade Formations – 600 to 850 feet bgs
- TCE is present in the groundwater on the Site in the Roubidoux Formation

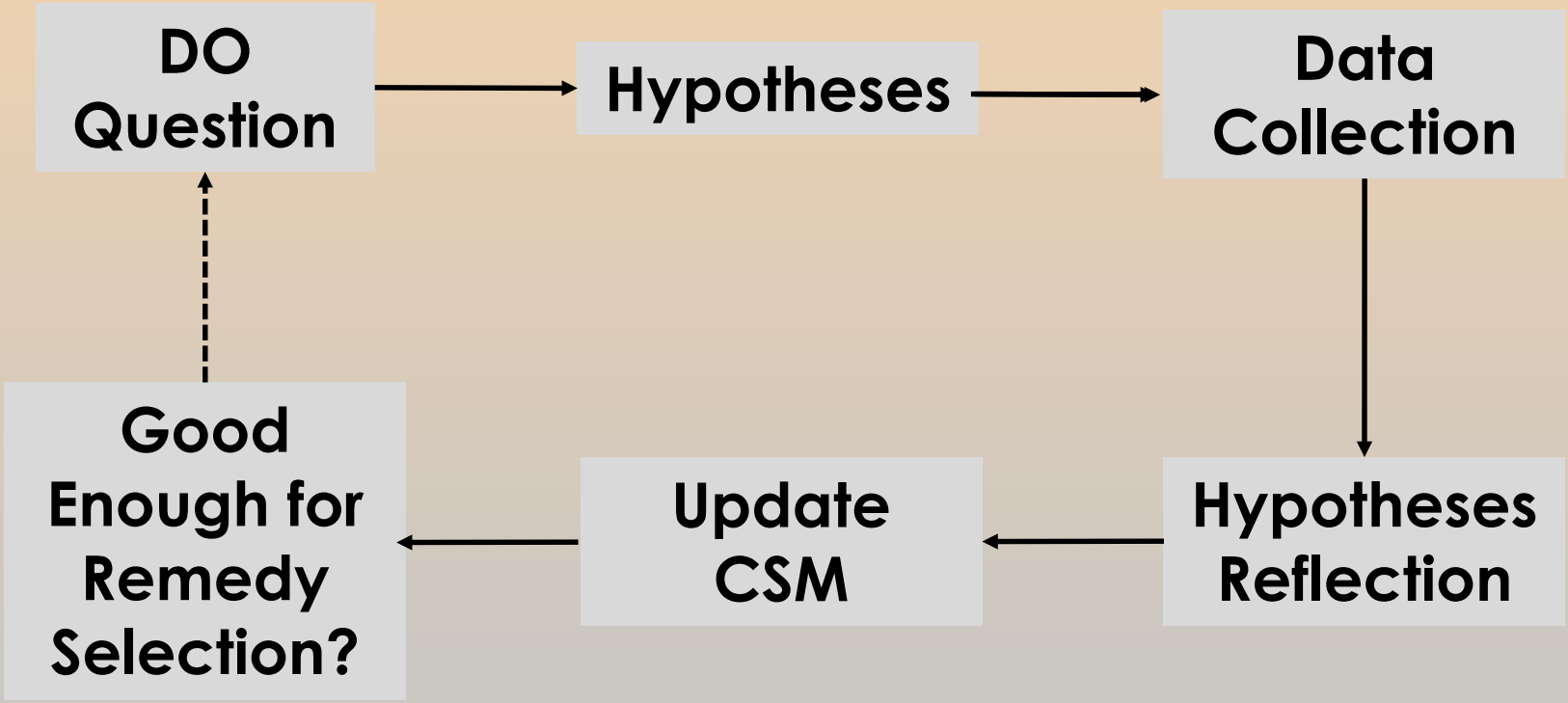
What We Know

- It is technically infeasible to hydraulically capture contaminant mass in the karst system under dynamic flow conditions

Data Objectives (DOs) - Developing a Final Remedy

"We usually do our long-range planning at the last minute."

DO Flow Chart



Data Objectives

Impacts to Domestic Wells

1. How is TCE getting from the Site to Domestic Wells:
   a) East of the Site near Ritter Springs?
   b) North of the Site near Fantastic Caverns?
   c) South of the Site (York and Harvey Wells)?

Data Objectives

Springs

2.How is TCE getting in Springs:
   a)East of the Site at Ritter Springs?
   b)North of the Site near Fantastic Caverns?

Data Objectives

Caverns

3. How is TCE getting into the Caverns in the Vapor Phase?

Data Objectives

On-Site Source Mass

4. With Regards to TCE and other Constituents of Concern (COC) on the Site:
   a) What is the Nature and Extent of Source Mass in Saturated Clays and Bedrock Fractures?
   b) What is the Feasibility of Further Reducing Source Mass through Active Remediation?

Data Objectives

Off-Site Soil Vapor and Indoor Air

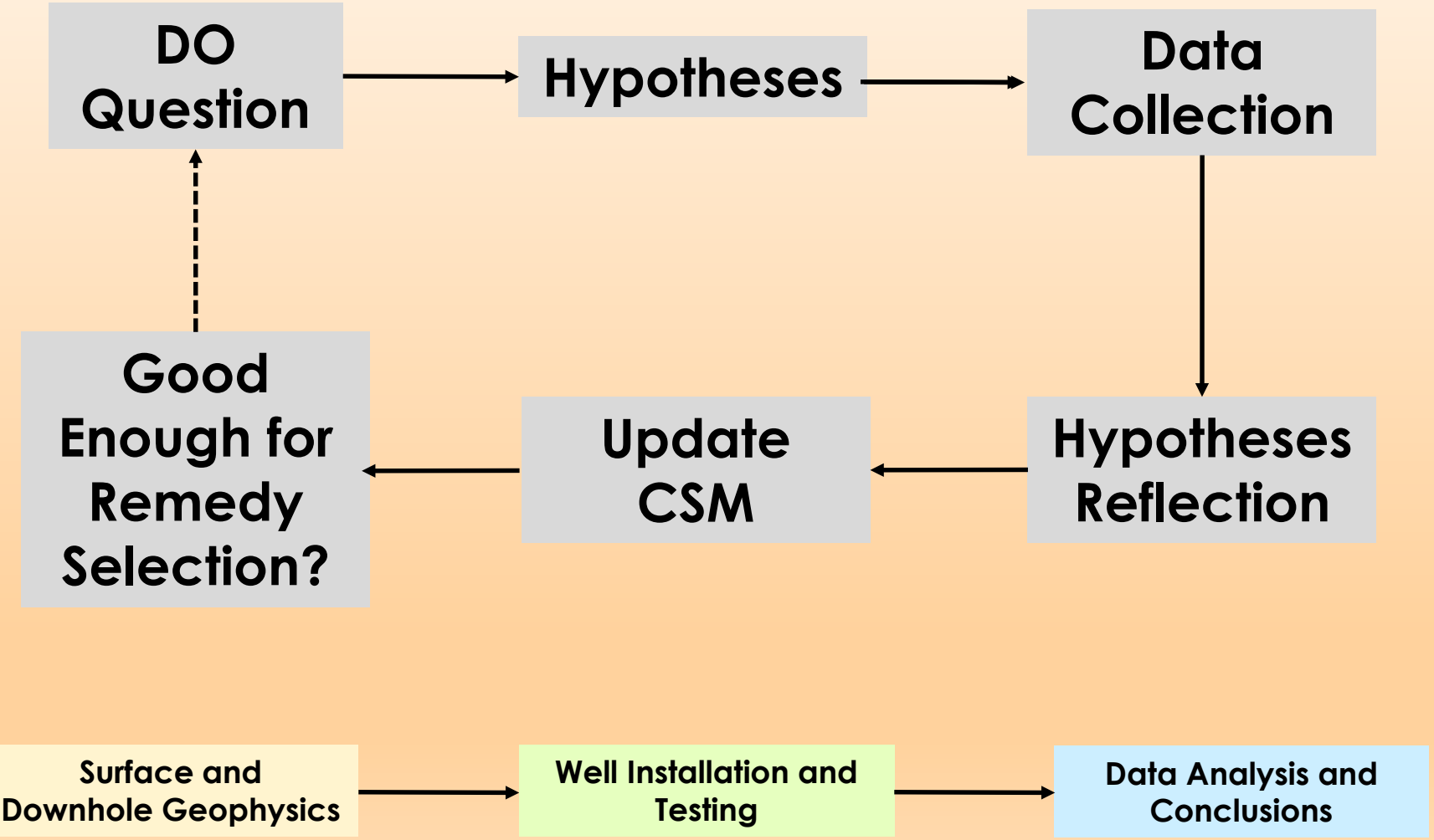
5. With Regards to VOCs in Soil Vapor to the West of the Site on the Airport Property:
   a) What is the Nature and Extent of VOCs in Soil Vapor?
   b) Are there Concentrations of VOCs in the Indoor Air of Hangers?

Data Objectives

Hydraulics

6. Is it Feasible to Provide Hydraulic Capture of Groundwater in the Springfield and Ozark Aquifers on and in Immediate Proximity to the Site?

DO Flow Chart

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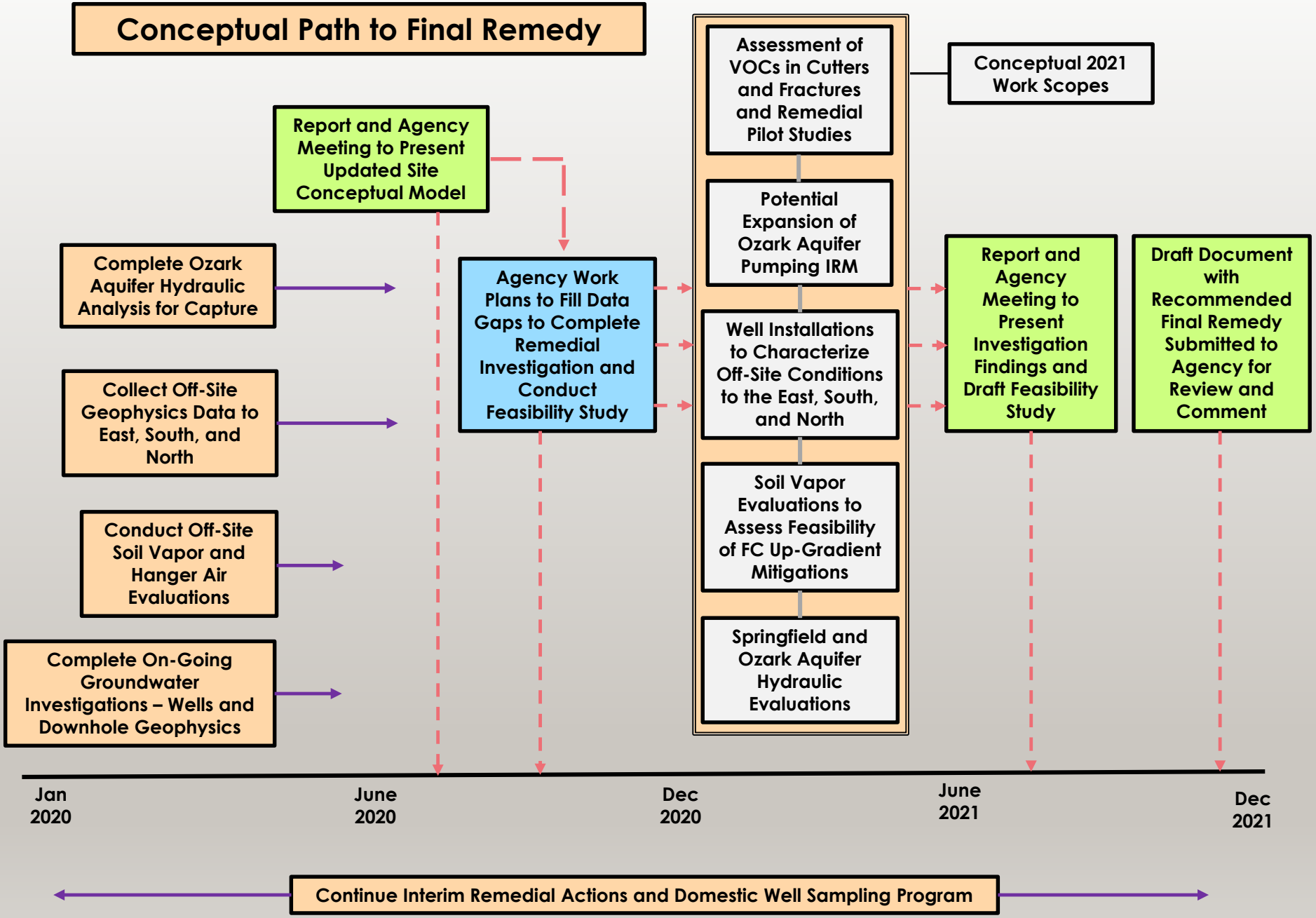
Conceptual Path to Final Remedy



List of 2020 Activities

- Groundwater Monitoring
- Treatment System OMM
- Treatment System Expansions
- Downhole Geophysics
- Surface Geophysics
- Well Installations and Testing
- On-Site Source Area Evaluations
- Caverns "Support"


THE END